Lay Creek

Site Specific Analysis

Craig District Office
Bureau of Land Management
Craig, Colorado

November, 1982

TABLE OF CONTENTS

1. Introduction

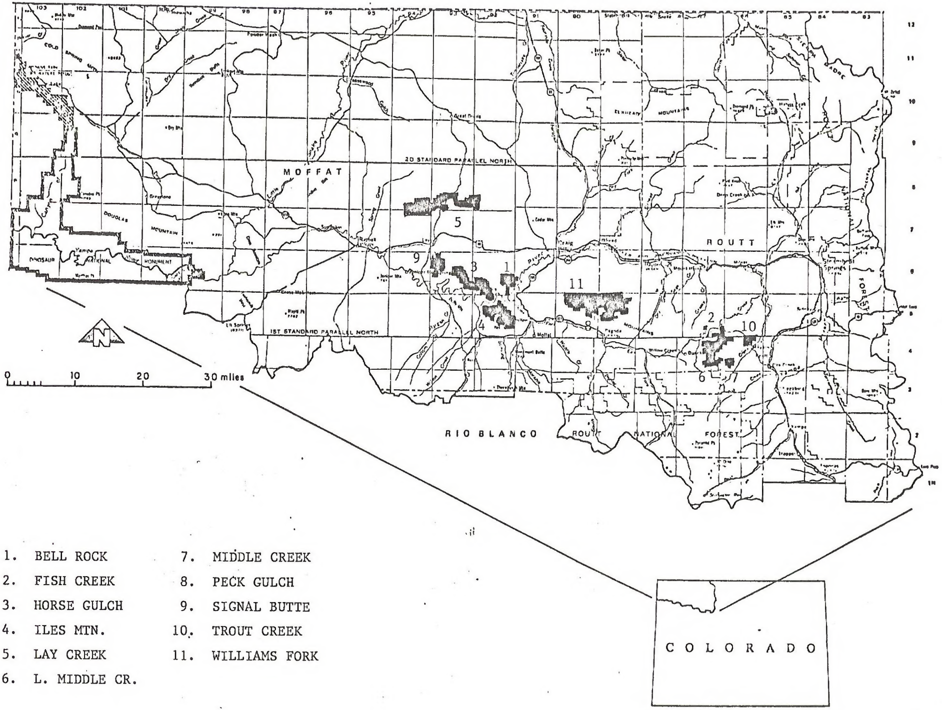
This tract is located in Moffat County, Colorado. The tract lies sixteen miles northwest of Craig, Colorado (Map 1) in T. 7 N., R. 94 W.; T. 89 N., R. 92 W.; T. 8 N., R. 93 W., and T. 8 N., R. 94 W.

The site specific analysis is an assessment of the impacts to the environment based on assumptions of how the coal, in a specific tract, would be developed. The assumptions used for analysis for this tract are found in the Lay Creek Tract Profile Report (Bureau, 1982). See Map 2 for disturbed areas on tract.

1.1 Alternatives

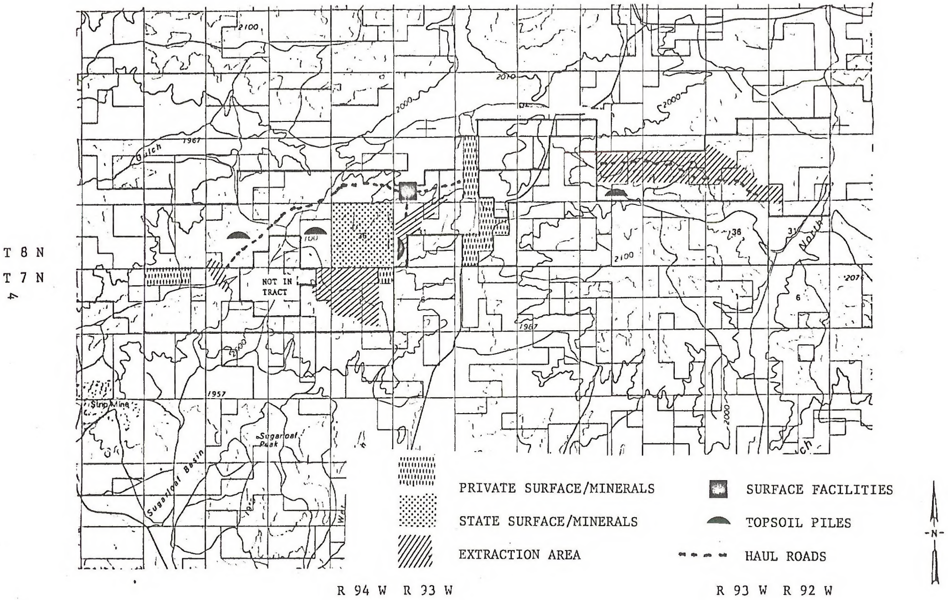
This site specific analysis assesses the impacts of the Development Alternative New Mine Scenario since the No Action Alternative would not impact the natural environment. This Development Alternative assumes that the tract would be leased and developed s a new surface mine. A full discussion of the Development and No Action Alternative can be found in the Lay Creek Tract Profile Report (Bureau, 1982).

MAP 1



1. BELL ROCK
2. FISH CREEK
3. HORSE GULCH
4. ILES MTN.
5. LAY CREEK
6. L. MIDDLE CR.
7. MIDDLE CREEK
8. PECK GULCH
9. SIGNAL BUTTE
10. TROUT CREEK
11. WILLIAMS FORK

Map 2



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2. Climate and Air Quality

Not available.

3. Geology

3.1 Affected Environment

3.1.1 Topography

The tract is located approximately 16 miles northwest of Craig, Colorado and 12 miles northeast of Maybell, Colorado in Moffat County, Colorado. The general topography of the tract is characterized by south facing escarpments, gentle north facing dipslopes, well incised drainages and a broad alluvial valley along Lay Creek. The tract is drained by numerous ephemeral and one intermittent stream, Lay Creek, all of which eventually join the Yampa River four miles to the south.

3.1.2 Stratigraphy

The rock formations outcropping on tract range in age from Late Cretaceous to Miocene and include the coal bearing Lance and Fort Union Formations (Figure 3-1).

The Lance Formation of Late Cretaceous age rests conformably on the Fox Hills sandstone. Locally, the Lance may be as much as 1000 feet thick consisting of a non-marine sequence of sandstone, siltstone, carbonaceous shale, and occasional coal beds (Haun, 1961).

Unconformably overlying the Lance Formation, the Fort Union Formation of

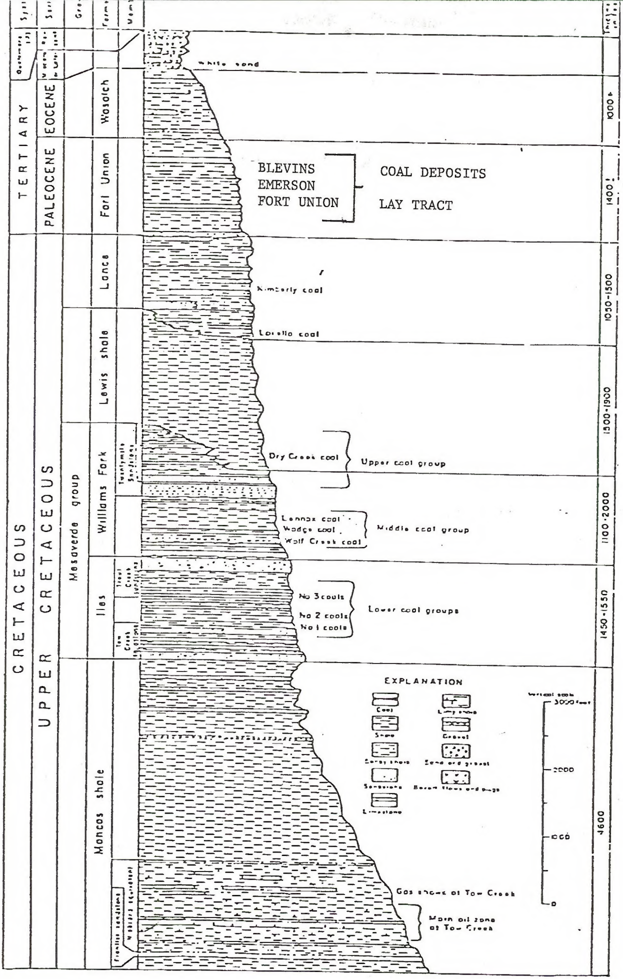

Figure 3-1. Generalized stratigraphic section, northwest Colorado (Bass, Eby, and Campbell, 1955).

Paleocene Age outcrops over most of the tract. The Fort Union is approxmately 1100 feet thick on tract and consists of a basal conglomerate, sandstone, gray shale, and the coal beds of interest in this report.

The Wasatch Formation unconformably lies on the Fort Union Formation. This formation may be as thick as 1100 feet and consists of gray to red shale and clay interbedded with coarse brown sandstone (Bass et al., 1955) although it is probably less on tract.

The Browns Park Formation of Miocene Age which outcrops in the extreme southwest corner of the tract, rests unconformably on the older formations in the area. Basically, the Browns Park is a terrestrial formation consisting of siltstone, claystone and loosely consolidated eolian tuffaceous sandstone (Tweto, 1976).

3.1.3 Structure

The tract is regionally located in the southern extension of the Sand Wash Structural Basin. The basin is bordered on the east by the Park Range and on the southwest by the Axial Basin Anticline (Figure 3-2). The basin itself is complexly modified by numerous anticlines, synclines, and faults.

Locally the tract lies on the north flank of the Mud Spring Anticline. The anticlinal axis trends N 50° W (BLM, Bureau of Reclamation, 1981). Dips on tract range from 5 to 12 degrees to the north and northwest but become slightly less in the subsurface (Dames and Moore a& b, 1979).

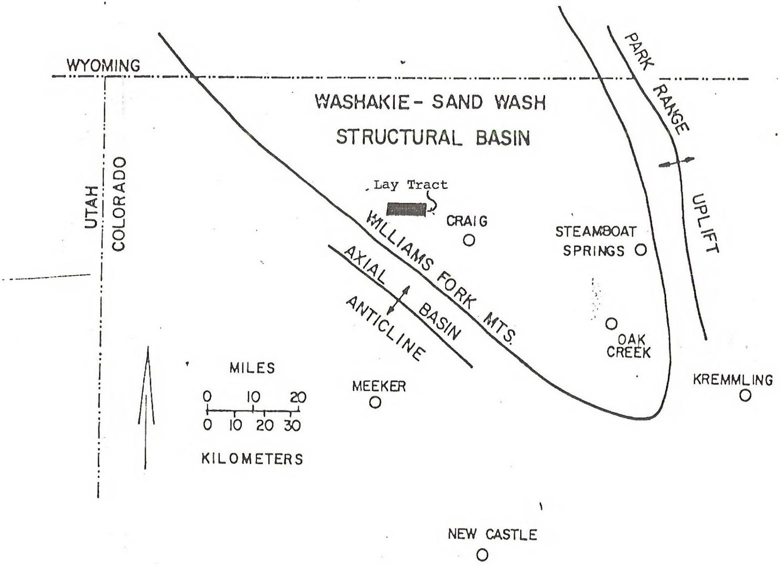

Figure 3-2. Generalized Structural Setting
(Energy Fuels Corp.,1979.)

No major faults have been identified on tract, although numerous faults exist south of the tract, some as close as one-quarter mile. Minor faulting associated with these faults may be present on tract but have not been identified.

3.1.4 Minerals

3.1.4.1 Coal

The coal deposits of the Lay tract are in the Yampa Coal Field and are considered to be subbituminous in rank.

Within the tract the Fort Union Formation contains three coal zones with economically surface mineable coal beds. The lower zone contains several coal beds up to 10 feet thick. An unnamed lower coal zone (Fort Union 20) was correlated across part of the tract. Fort Union (20) ranges in thickness from 4.6 to 10 feet, but exceeds 17 feet in some places. The middle zone contains one very thick coal bed called the Emerson Bed. The Emerson Bed can be correlated across most of the tract and ranges in thickness from 10 to over 25 feet, while averaging 20 feet. Towards the western and eastern margins of the tract the Emerson Bed pinches out. The upper coal zone consists of the Blevins Bed. The interburden between the Emerson and Blevins ranges from less than 200 to more than 250 feet across the tract. The Blevins Bed ranges in thickness from 4 to 17+ feet, but averages 10 feet across the tract. Analysis of the Fort Union coals indicate the following average results:

Moisture	13%
Ash	8%
Sulfur	.49%
Volatile Matter	33.47%
Fixed Carbon	45.5%
BTU/lb	10,300

Total surface minable coal resources for the tract were computed by Minerals Management Service and Bureau of Land Management to be 59.2 million tons. Recoverable resource based on a recovery of 85% were computed to be 50.3 million tons. A summary of the coal resources by individual coal zone is illustrated on Table 3-1.

TABLE 3-1

RECOVERABLE COAL RESOURCES OF THE LAY TRACT

Coal Seam	Thickness (feet)	Total Resource (million tons)	Resource x .85 Recovery Factor
Fort Union (20)	9	1.8	1.5
Emerson	20	38.0	32.3
Blevins	10	19.4	16.5
Total	39	59.2	50.3

3.1.4.2 Oil and Gas

There is no oil and gas production from the tract although two wells were drilled and subsequently plugged and abandoned. Numerous oil and gas pools are located in the Sand Wash Basin, suggesting the tract may be valuable for

oil and gas production. Production from other pools and fields in the area is from the Niobrara Shale, Mancos Formation, Dakota Sandstone, Morrison Formation, Entrada Sandstone, Shinarump Formation, and the Weber Sandstone. All of these formations can be found at depth beneath the tract. Approximately 3640 acres of the tract are presently covered by various oil and gas leases.

3.1.4.3 Locatable Minerals

Uranium is known to occur in the Browns Park Formation which outcrops in the extreme southwest corner of the tract in the SW 1/4 SW 1/4, Sec. 4, T. 7 N., R. 94 W. Because of the minor amount of Browns Park on tract the potential for an economic deposit is extremely low.

Gold placer deposits have been known for many years in and around the Lay, Colorado area. North of Lay the richest gold is in a bed of sand and gravel in terraces 20 to 100 feet above the present Creek. A well defined source rock is lacking. Lack of water handicapped development, but in spite of this a moderate production was obtained as recently as 1933 to 1936 when 26 ounces of fine gold was produced (Vanderwilt, 1947).

Numerous gold placer and uranium lode claims are present throughout the tract. Whether or not any of the claims contain economic deposits at this time or in the future is unknown.

3.1.4.4 Saleable Minerals

Alluvium and colluvium deposits consisting of unconsolidated rock debris, sand, silt, and clay are found in the drainages and valleys of the tract.

3.1.5 Paleontology

The Lance Formation is generally considered to be non-fossiliferous although a few leaf impressions and vertebrate fossils have been found (Bureau, 1976). Vertebrate fossils and fossil leaves also occur in the Fort Union and Wasatch formations, respectively (Figure 3-3). Also found in the Wasatch are ostracods and gastropods (Bureau, 1976). None of these fossils are found in abundance in the Lay Creek Area; those found, however, with the exception of vertebrate fossils, are considered common and of limited scientific value. Vertebrate fossils are considered important and would be protected by the committed mitigation (Section 3.2.9).

3.2 Environmental Consequences

3.2.1 Coal

The major geologic impact of the Lay tract would be the amount of coal mined, consumed and left on tract as unrecoverable due to present mining technology. Over a 30 year mine life, approximately 50.3 million tons of coal could be surface mined. An estimated 8.9 million tons of coal would be left on tract in the margins of the mined areas and mixed in the overburden.

ERAS	AND SYSTEMS	AND SERIES	FORMATION	ENVIRONMENT	COMMON FOSSILS PRESENT	REFERENCES
CENOZOIC	TERTIARY	Miocene	Browns Park Formation	Fluvial Lacustrine; Eolian, Tuffs Airborne From Distant Volcanoe	Ostracodes and Diatoms Vertebrate Fossils; Camel, Horse	Tapstd, 1965 Peterson, 1928 McGrew, 1951
		Miocene	Bishop Conglonbrate	Fluvial	Non Fossiliferous	
		Eocene	Bridger Formation	Fluvial	Vertebrate Fossils	Gazin, 1959
		Eocene	Green River Formation	Fluvial Lacustrine	Vertebrate Fossils; Fossil Fish, Fossil Leaves and Insects. Fresh Water Gastropods and Pelecypods	Robinson, 1974 Bradley, 1964
		Paleocene and Eocene	Wasatch Formation	Fluvial and Lacustrine	Vertebrate Fossils, Mammals Some Ostracodes and Gastropods. Fossil leaves, Genus Aralia	Miser, 1929 McKenna, 1955
		Paleocene	Fort Union Formation	Fluvial in Part of Swamps and Marshes	Vertebrate Fossils Fossil Leaves	Robinson, 1974 Hansen, 1965
		Paleocene	Ohio Creek Formation	Fluvial	Non Fossiliferous	
MESOZOIC	CRETACEOUS	Upper Cretaceous	Lance Formation	Fluvial Import Swamps	Non Fossiliferous; A few leaf fossils; Vertebrate fossils	Dorf, 1910 Robinson, 1974
		Upper Cretaceous	Lewis Shale	Marine off-shore	All Marine Fossils--Ammonites, Pelecypods, Crinoids, Gastropods	Hancock, 1925 Miser, 1929 Dorf, 1938, 1942
		Upper Cretaceous	MESAVERDE GROUP: Williams Fork Formation	Fluvial in Part Swamps Litteral some Marine Shales	Fossil plants from Genera Picus, Myrica, Eriocaulos, & Salix. Fossil Leaves in Coal. Ammonities & Inoceramus Clams in Marine Shales. Pelecypods, Gastropods	Hancock, 1925 Miser, 1929 Bass, Eby, Campbell, 1955
		Upper Cretaceous	MESAVERDE GROUP: Iles Formation	Fluvial in Part Swamps Litteral some Marine Shales	Pelecypods, Fossil Leaves in Steamboat Springs & in the Coal Ammonities and Inoceramus Clams in Marine Shales--Fossil Plants of Genera Picus & Halymenites	Hancock, 1925 Miser, 1929 Bass, Eby, Campbell, 1955
		Upper Cretaceous	Mancos Shale	Marine Offshore	Ammonites--Baculites Scaphites, Inoceramus Clams Pelecypods, Cephalopods	Hancock, 1925 Miser, 1929
		Upper Cretaceous	Frontier Sandstone	Marine Brackish Water	Pelecypods, Shark Teeth, and Plant Fossils	
		Lower Cretaceous	Mowry Shale Member of Mancos	Marine Offshore	Carbonized Wood, Cyclord Fish Scales, Fish Bones	
		Lower Cretaceous	Dakota Sandstone	Fluvial, Marshes and Swamps	Silicified Wood, Ferns Dinosaur, Mollusk	Waage, 1959

Figure 3-3 Fossiliferous formations in northwest Colorado (BLM, 1976).

3.2.2 Topography

Destruction of the natural topography and disruption of the subsurface strata in the mined areas would also be unavoidable. Backfilling and surface reclamation of the mined area would result in a natural appearing topography.

3.2.3 Landslides

Dip slope conditions (5 to 12 degrees) on tract make the area susceptible to landsliding, especially in areas of surface disturbance. Because the topographic slopes are relatively gentle, 7 to 10 degrees, and areas of surface disturbance must be reclaimed, the effects of landsliding would be insignificant.

3.2.4 Faulting

Geologic hzards associated with faulting should be insignificant since no major faults have been identified on tract and the tract is considered to be located in a low seismicity zone.

3.2.5 Minerals

No major impacts to locatable or saleable minerals is expected on the tract. According to Public Law 585, the Multiple Mineral Development Act, any conflicts arising between coal and other minerals must be resolved by the respective lessees and/or claimants.

3.2.6 Paleontology

No significant impact. See Section 3.2.9 for committed mitigation.

3.2.7 Irreversible/Irretrievable Commitment of Resources

The coal mined, consumed and left underground as unrecoverable due to present mining technology would be irretrievably lost to future uses. An estimated 50.3 million tons of coal would be removed from the tract and an additional 8.9 million tons left on tract in the margins of the mined areas and mixed in the overburden.

The topography and subsurface strata in the mined areas would be irreversibly altered by surface mining.

3.2.8 Short Term Use vs. Long Term Production

Short term use of the tract for the surface mining of coal for 30 years would mean the permanent loss of 50.3 million tons of coal and an estimated 8.9 million tons considered unrecoverable due to present mining technology. If coal is not mined at present, improvements in mining technology could increase long term coal production.

3.2.9 Committed Mitigation Paleontology

(1) Before undertaking any surface disturbing activities on the leased land,

the lessee shall contact the appropriate District Office of the Bureau of Land Management to determine if the leased lands fall within a Class I-a or Class I-b paleontological classification area.

(2) If the leased lands fall within a Class I-a or Class I-b area or in areas not classified yet, a paleontological survey shall be required to establish the presence or absence of scientifically significant fossils as defined in IM CO-80-398 Change 2. No paleontological surveys will be required in Class II or Class III areas.

(3) The paleontological survey shall be conducted by the appropriate BLM district and/or area geologist, if available. Otherwise, it shall be conducted by a qualified paleontologist approved by the BLM district geologist.

(4) If scientifically significant fossils are encountered during the survey, the lessee's mining plan shall address appropriate steps for salvaging and/or avoiding the fossils.

(5) Should any vertebrate fossils be uncovered during any surface disturbing activities or during any mining operations, the BLM district geologist shall be contacted immediately, as well as the Director of the Technical Center (OSM), or the District Mining Supervisor, as appropriate. Operations may continue as long as the fossils are not destroyed or lost by the activity. An evaluation of the fossils shall be completed by the BLM district geologist or a BLM-approved paleontologist within five working days, and the lessee will be notified of what actions will be taken.

(6) All scientifically significant fossils shall remain under the jurisdiciton of the United States until ownership is determined under applicable law. Copies of all paleontological resource data generated as a result of the lease term requirements shall be provided to the BLM district geologist, and to the Director of the Technical Center (OSM), or the District Mining Supervisor, as appropriate.

(7) The cost of any required salvage of such fossils shall be borne by the United States.

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THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek Tract

State: Colorado

Leasing/Development Scenario: New Operator/Surface

Resource Element	Committed Mitigation	Anticipated Impact: Baseline	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Geologic hazards		Low	→	→	→	→	Good		Topographic slopes <10°; near dip slope conditions, 5°-12° dip
Seismic activity		None	→	→	→	→	Good		Low seismic zone; no major faults
Potential for other minerals	Multiple Mineral Development Act	Low	→	→	→	→	Fair		No present conflict; potentially valuable for oil and gas, uranium, gold production
Paleontology (Invertebrate)	See narrative	Low	→	→	→	→	Fair	Loss of fossil remains	Beneficial effect of exposure

4. Soils

4.1 Affected Environment

The soils within the tract are extremely variable depending on parent materials, slope, aspect and location on slopes. The soils on tract are formed primarily from weathered fine grained sandstone, shale and some siltstone with additional material derived from water deposited alluvium and windblown sands. The dominant soils are moderately deep to deep, well drained and have loam to fine sandy loam surface textures and calcareous subsoils. The soils are primarily Aridisols, meaning that for three months out of the year, when the soil is warm enough for plant growth there is a soil moisture deficit (Soil Survey Staff, 1975). For this reason the Lay Tract soils tend to be droughty and low in organic matter. Bottomland soils occur on stream terraces, floodplains, alluvial fans and in swale positions. These valley soils which have slopes less than five percent are located primarily along Lay Creek and Bord Gulch. Only a few small scattered areas of these soils are located in the western portion of the tract. These soils are moderate to highly calcareous and are susceptible to flooding. Small areas are included with a water table within 25 inches of the surface. Upland soils occur on mountain sideslopes, very steep to nearly barren hillsides, and ridge tops. There are also escarpment faces and vertical sandstone ledges found on tract. The overburden material and the material separating the coal beds was determined unsuitable when considered as a plant growth media (USDI, 1981) because of high sodium and soluble salt content.

The Soil Conservation Service has completed a third order soil survey of the tract and the series descriptions used in this report are contained in the Moffat County Soil Survey Report (manuscript subject to revision). The tract contains 36 mapping unit; refer to the Soil Map Legend (Table 4-1) and the Soil Maps (Figures 4-1 and 4-2). Included in these 36 mapping units, 29 soils are mapped at the series level and 7 are mapped as complexes of soil series, broadly defined soils and miscellaneous landforms. The physical characteristics and soils limitations for reclamation on the tract have been condensed from the Moffat County Soil Survey Report and SCS Interpretation Records and are shown in Table 4-2 and Table 4-3 respectively.

4.1.1 Prime and Unique Farmlands

There are no known prime and unique farmlands occurring on tract. However, prime and unique farmland mapping has not been completed in Moffat County. Mapping units 03B and 04A have been identified as important farmlands in Moffat County.

TABLE 4-1

SOIL LEGEND - MOFFAT COUNTY

Symbol	Mapping Unit Name
03B	Havre fine sandy loam, 0 to 5% slopes
03S	Havre silt loam, saline, 0 to 5% slopes
04A	Glendive loam, 0 to 3% slopes
7C	Evanston loam, 3 to 12% slopes
08B	Bryan clay loam, 3 to 12% slopes
23D	Cruckton loamy sand, 5 to 15% slopes
26D	Peyton sandy loam, 3 to 12% slopes
26E	Peyton sandy loam, 12 to 25% slopes
28D	Forelle loam, 3 to 12% slopes
28E	Forelle loam, 12 to 25% slopes
31E	Busby sandy laom, 12 to 25% slopes
32D	Yamac loam, 5 to 15% slopes
32E	Yamac loam, 15 to 30% slopes
33D	Pinelli loam, 3 to 12% slopes
35C	Tisworth sandy loam, 0 to 9% slopes
39C	Hereford sandy loam, 3 to 12% slopes
47D	Pinelli clay loam, 3 to 15% slopes
47E	Pinelli clay loam, 12 to 25% slopes
52D	Cushool fine sandy loam, 3 to 12% slopes
52E	Cushool fine sndy loam, 12 to 25% slopes
54E	Yetull loamy sand, 12 to 25% slopes
56D	Zeona loamy sand, 3 to 12% slopes
58D	Bulkley silty clay loam, 3 to 12% slopes
62D	Rock River sandy loam, 3 to 12% slopes
66D	Relsob sandy loam, 3 to 12% slopes
X66	Relsob-Unnamed sandy loam, 3 to 15% slopes
67	Relsob-Gretdid sandy loam, 10 to 20% slopes
69	Homelake loam, 0 to 3% slopes
101	Torriorthents-Rock outcrop complex, very steep
105	Kemmerer-Moyerson silty clay loams, 20 to 40% slopes
110E	Kemmerer silty clay loam, 12 to 25% slopes
X110	Kemmerer-Yamac complex, 5 to 30% slopes
115	Yetull-Unnamed Lithic Ustic Torriorthents complex, steep
116	Grieves-Lithic Torriorthents-Cushool complex, 10 to 40% slopes
151D	Ryan Park loamy sand, 5 to 15% slopes

Figure 4.1
SOILS MAP
Sheet No. 1

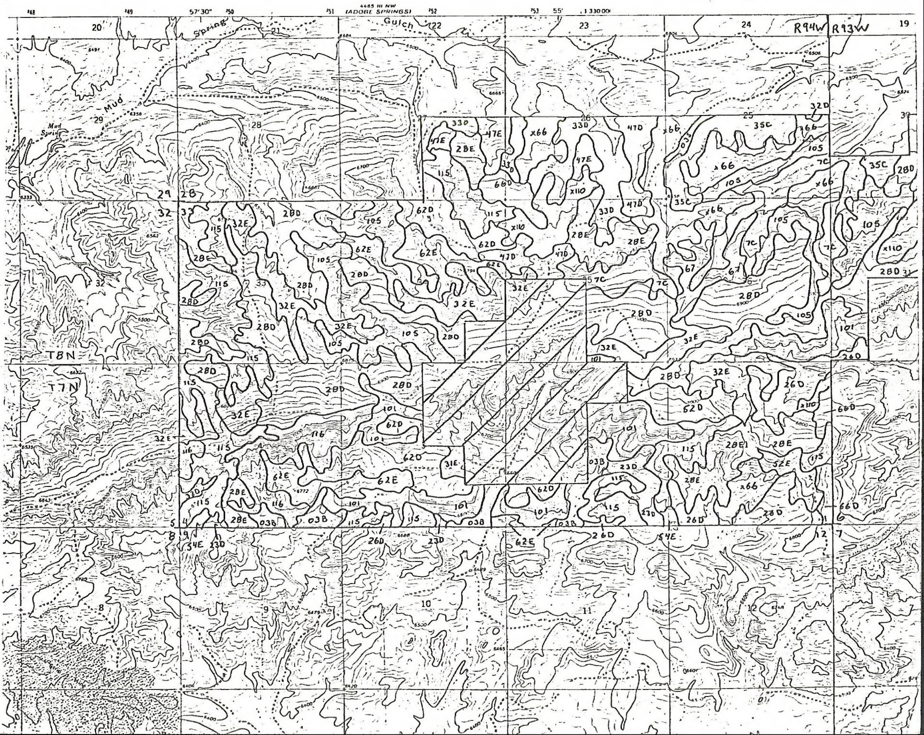


Figure 4.2
SOILS MAP
Sheet No. 2
Joins Sheet No. 1
R93W R92W
T8N
T7N
Drill Hole
Creek
Fork
North
Bord
Gulch
Well
62D
62E
26E
26D
101
105
08B
03B
32D
32E
31E
28D
66D
115
151D
04A
33D
54E
69
x66
39C
31E

TRACT NAME OR NUMBER: Lay Tract

TABLE 4-2 SOIL DESCRIPTORS

MAPPING UNIT							SURFACE			SUBSURFACE		
Symbol	Name	Extent Composition %	Landscape Position	Slope %	Depth and Drainage Class	Texture	Depth (Inches)	pH	Texture	Depth (inches)	pH	Parent Material
03B	Havre fine sandy loam	162 Ac/2%	Nearly level to gently sloping alluvial valley floors	0-5	Deep and well drained	Fine sandy loam	3	7.4-8.4	Stratified loam and silty clay loam	Extending to 60" or more	7.4-8.4	Stratified alluvium from shale and sandstone
03S	Havre silt loam saline	10 Ac/0.1%	Nearly level floodplains and stream terraces	0-5	Deep and moderately well drained	Silt loam	4	7.4-9.0	Stratified very fine sandy loam to silty clay loam	Extending to about 60"	7.4-9.0	"
04A	Glendive loam	69 Ac/0.7%	Occurs on nearly level floodplains and stream terraces	0-3	Deep and moderately well drained	Fine sandy loam	9	6.6-8.4	Calcareous stratified fine sandy loam and loamy sand	Extending to about 60"	7.4-9.0	Stratified mixed alluvium
7C	Evanston loam	228 Ac/3% of the tract	Gently sloping to strongly sloping terraces and valleys	3-12	Deep and well drained	Loam	8	6.6-7.8	Calcareous loam to clay loam	Extending to about 60"	7.4-9.0	Formed in loess from mixed sources

TRACT NAME OR NUMBER: Lay Creek

TABLE 4-2 SOIL DESCRIPTORS

MAPPING UNIT		Extent	Landscape	Slope	Depth and		SURFACE			SUBSURFACE		Parent
Symbol	Name	Composition %	Position	%	Drainage Class	Texture	Depth (Inches)	pH	Texture	Depth (inches)	pH	Material
08B	Bryan clay loam	497 Ac/5%	Gently sloping alluvial valley floors and stream terraces	3-12	Deep and well drained	Sandy clay loam	5	7.4-8.4	Sandy clay loam to sandy loam	Extending to about 60"	7.4-8.4	Formed in alluvium primarily from shale
23D	Cruckton loamy sand	59 Ac/0.6%	Gently sloping valley sideslopes and benches	5-15	Deep and well drained	Loamy sand	7	5.6-7.3	Sandy loam to loamy coarse sand	Extending to 60" or more	6.1-7.3	Developed in Arkosic sands
26D	Peyton sandy loam	237 Ac/2%	Gently sloping to strongly sloping valley benches and sideslopes	3-12	Deep and well drained	Sandy loam	6	6.1-7.3	Coarse sandy loam	Extending to 60" or more	6.6-7.3	Developed in residuum from Arkosic sands
26E	Peyton sandy loam	68 Ac/0.7%		12-25	"	"	"	"	"			
28D	Forelle loam	1533 Ac/15%	Terraces and upland sideslopes	3-12	Deep and well drained	Loam to sandy loam	4	6.6-7.8	Loam to clay loam	Extending to 60" or more	7.0-9.0	Eolian and alluvium deposits from sedimentary rocks
28E	Forelle loam	252 Ac/3%	"	12-25	"	"	"	"	"			
31E	Busby sandy loam	61 Ac/0.6%	Occurs on moderately steep terraces and sideslopes	12-25	Deep and well drained	Fine sandy loam	2	7.4-7.8	Fine sandy loam	Extending to 60" or more	7.9-8.4	Developed in alluvium derived from shale

TRACT NAME OR NUMBER: Lay Tract

TABLE 4-2 SOIL DESCRIPTORS

MAPPING UNIT

Symbol	Name	Extent Composition %	Landscape Position	Slope %	Depth and Drainage Class	Texture	SURFACE Depth (Inches)	pH	Texture	SUBSURFACE Depth (inches)	pH	Parent Material
32D	Yamac loam	205 Ac/2%	Occurs on upland ridges and benches	5-15	Deep and well drained	Loam	5	6.6-8.4	Loam	Extending from 20 to 60"	7.9-8.4	Developed in weathered sandstone siltstone and windlain deposits
32E	Yamac loam	459 Ac/5%	"	15-30	"	"	"	"	"			
33D	Pinelli loam	216 Ac/2%	Gently to strongly sloping upland benches and swales	3-12	Deep and well drained	Loam	6	6.6-7.8	Heavy clay loam	Extending to 60" or more	7.0-9.0	Formed in alluvium and residuum primarily from shale
35C	Tisworth sandy loam	116 Ac/1% of the tract	Occurs on upland benches, toeslopes and stream terraces	0-9	Deep and well drained	Fine sandy loam	3	>7.8	Light clay loam to calcareous clay loam	Extending to 60" or more	>8.4	Formed in alluvium and residuum from shale
39C	Hereford sandy loam	31 Ac/0.3%	Gently sloping valley sideslopes and benches	3-12	Deep and well drained	Sandy loam	10	6.6-7.8	Sandy clay loam, sandy loams to fine sand	Extends to about 60"	7.0-8.4	Colluvium and residuum from sandstone
47D	Pinelli clay loam	102 Ac/1%	Gently sloping to strongly sloping toeslopes and sideslopes of ridges	3-15	Deep and well drained	Clay loam	4	6.6-7.3	Clay to sandy clay loam	Extending to 60" or more	7.3-8.4	Formed in weathered shale
47E	Pinelli clay loam	66 Ac/0.6%		12-25	"							

TRACT NAME OR NUMBER: Lay Creek

TABLE 4-2 SOIL DESCRIPTORS

MAPPING UNIT

Symbol	Name	Extent Composition %	Landscape Position	Slope %	Depth and Drainage Class	SURFACE Texture	SURFACE Depth (Inches)	pH	SUBSURFACE Texture	SUBSURFACE Depth (inches)	pH	Parent Material
52D	Cushool fine sandy loam	70 Ac/0.7%	Gently sloping to strongly sloping foothill sideslopes	3-12	Moderately deep and well drained	Fine sandy loam	5	6.6-8.4	Heavy loam to fine sandy loam to loamy sand	Extends to about 25"	7.4-9.0	Formed in soft sandstone
52E	Cushool fine sandy loam	40 Ac/0.4%		12-25								
54E	Yetull loamy sand	79 Ac/0.8% of the tract	Gently to strongly sloping foothill sideslopes	12-25	Deep and somewhat excessively drained	Loamy sand	15	7.4-7.8	Loamy sand and sand	Extending to 60" or more	7.4-8.4	Formed in eolian and residual sands
56D	Zeona loamy sand	20 Ac/0.2%	Gently sloping foothills and alluvial fans	3-12	Deep and excessively drained	Loamy sand	3	6.6-7.8	Sand	Extending to 60" or more	6.6-8.4	Formed on eolian and alluvium
58D	Bulkley silty clay loam	18 Ac/0.2%	Upland sideslopes and toeslopes	3-12	Deep and well drained	Silty clay loam	4	7.4-8.4	Silty clay to a calcareous silty clay	Extends about 50"	7.9-8.4	Developed on clayey shale
62D	Rock River sandy loam	1022 Ac/10%	Valley sideslopes and benches	3-12	Deep and well drained	Fine sandy loam	4	6.6-7.3	Fine sandy clay loam to a calcareous fine sandy loam	Extends to 60" or more	7.0-9.0	Sandy outwash and alluvium
62E	Rock River sandy loam	304 Ac/3%		12-25								

TRACT NAME OR NUMBER: Lay Creek

TABLE 4-2 SOIL DESCRIPTORS

MAPPING UNIT

Symbol	Name	Extent Composition %	Landscape Position	Slope %	Depth and Drainage Class	SURFACE Texture	SURFACE Depth (Inches)	pH	SUBSURFACE Texture	SUBSURFACE Depth (inches)	pH	Parent Material
66D	Relsob sandy loam	271 Ac/3%	Gently sloping to strongly sloping sideslopes and benches	3-12	Deep and well drained	Sandy loam	8	6.6-7.8	Sandy clay loam to sandy loam to sand	Extends to about 60"	6.6-7.8	Formed in residuum from shale and sandstone
X66	Relsob-Unnamed sandy loam	715 Ac/7%	Gently to strongly sloping upland hills and ridges	3-15	Deep and well drained							Formed in residuum from shale and sandstone
	Relsob	45% of the mapping unit				Sandy loam	8	6.6-7.8	Sandy clay loam-sandy loam-sand	Extends to about 60"	6.6-7.8	
	Unnamed X66	25% of the mapping unit				Sandy loam	8	6.8-7.8	Sandy clay loam-silty clay loam	Extends to 60" or more	7.0-8.4	
	Inclusion of Cushool, Rock River and Unnamed 67	30% of the mapping unit										
67	Relsob-Gretdid sandy loams	108 Ac/1%	Moderately steep to strongly sloping mountain sideslopes benches and ridgetops	10-20	Deep and excessively drained							Formed in residuum weathered from Arkosic sandstone
	Relsob	60% of mapping unit				Sandy loam	8	6.6-7.8	Sandy clay loam-sandy loam-sand	Extends to about 60"	6.6-7.8	
	Gretdid	30% of mapping unit				Sandy loam	3	7.4-7.8	Sand	Extending to about 60"	7.3-7.3	

TRACT NAME OR NUMBER: Lay Creek

TABLE 4-2 SOIL DESCRIPTORS

MAPPING UNIT

Symbol	Name	Extent Composition %	Landscape Position	Slope %	Depth and Drainage Class	SURFACE Texture	SURFACE Depth (Inches)	SURFACE pH	SUBSURFACE Texture	SUBSURFACE Depth (inches)	SUBSURFACE pH	Parent Material
69	Homelake loam	199 Ac/2%	Occurs on the floodplain of Lay Creek	0-3	Deep and somewhat poorly drained	Loam	10	6.6-7.8	Loam to fine sandy loam to silty clay loam	Extending to an undetermined depth, water table below 25"	6.6-7.8	Developed in alluvium from mixed sedimentary sources.
101	Torriorthents-Rock outcrop complex	947 Ac/9%	Strongly to a very steep complex on terrace and escarpment faces and valley sideslopes	Very steep 15-90	Shallow to moderately deep and well drained	Coarse to medium textured and stony and cobbly	0-5	Varied	—		Varied	Alluvial and colluvial fans and sedimentary rock ledges
	Torriorthents	50% of the mapping unit								Extends 10-40"		
	Rockoutcrop	40% of the mapping unit								Less than 4"		
	Inclusions	10% of the mapping unit										
105	Kemmerer-Moyerson silty clay loam	600 Ac/6%	Steep to very steep soils on foothills and ridge crests	20-40								Formed in residuum from Lewis Shale
	Kemmerer	45% of the mapping unit			Moderately deep and well well drained	Silty clay loam	3	7.9-9.0	Calcareous silty clay loam to clay	Extends to about 28"	7.9-9.0	
	Moyerson	40% of the mapping unit			Shallow and well drained	Silty clay loam	1	7.4-9.0	Gravelly silty clay loam	Extends to about 17"	7.9-9.0	
	Inclusions of Pinelli	15% of the mapping unit										

TRACT NAME OR NUMBER: Lay Creek

TABLE 4-2 SOIL DESCRIPTORS

MAPPING UNIT

Symbol	Name	Extent Composition %	Landscape Position	Slope %	Depth and Drainage Class	SURFACE Texture	SURFACE Depth (Inches)	pH	SUBSURFACE Texture	SUBSURFACE Depth (inches)	pH	Parent Material
110E	Kemmerer silty clay loam	51 Ac/0.5%	Occurs on upland benches and sideslopes	12-25	Moderately deep and well drained	Silty clay loam	3	7.9-9.0	Calcareous clay to silty clay loam	Extends to about 24"	7.9-9.0	Developed on shale
X110	Kemmerer-Yamac complex	186 Ac/2%	Occurs on upland shale ridges with windlain deposits or on sandstone. Kemmerer occurs on ridges and sideslopes while Yamac occurs on ridges and toeslopes	5-30								
	Kemmerer	60% of the mapping unit			Mod. deep & well drained	Silty clay loam	3	7.9-9.0	Calcareous silty clay loam to clay	Extends to about 24"	7.9-9.0	Formed on weathered shale
	Yamac	20% of the mapping unit			Deep and well drained	Loam	5	6.6-8.4	Calcareous loam to clay loam	Extends from 20-60"	7.9-8.4	Formed in loess and sandstone residuum
	Inclusions	20% of the mapping unit										
115	Yetull-Unnamed Lithic Ustic Torriorthents complex very steep	727 Ac/7%	Moderately steep to steep soils on foothill sideslopes and ridgetops	20-50								Formed on residuum from Browns Park sandstone
	Yetull	45% of the mapping unit			Deep and exc. drained	Loamy sand	3	7.4-7.8	Calcareous loamy sand to sandy	Extends to about 48"	7.4-8.4	
	Unnamed Lithic Ustic Torriorthents	40% of the mapping unit			Shallow and excessively drained	Gravelly loamy sand	2	7.4-8.4	Calcareous very gravelly loamy sand	Extends to about 15"	7.4-9.0	
	Inclusions	15% of the mapping unit										

TRACT NAME OR NUMBER: Lay Creek

TABLE 4-2 SOIL DESCRIPTORS

MAPPING UNIT

Symbol	Name	Extent Composition %	Landscape Position	Slope %	Depth and Drainage Class	SURFACE Texture	SURFACE Depth (Inches)	pH	SUBSURFACE Texture	SUBSURFACE Depth (inches)	pH	Parent Material
116	Grieves-Lithic Torriorthents-Cushool complex	165 Ac/2%	Strongly sloping to steep escarpment breaks, and valley sides.	10-40								
	Grieves	40% of the mapping unit	Grieves occurs on toeslopes		Deep and well drained	Loamy fine sand	3	7.4-8.4	Fine sandy loam	Extends to about 60"	7.4-8.4	Alluvium from fine-grained sandstone
	Lithic Torriorthent	25% of the mapping unit	Occurs on backslope positions		Shallow and exc. drained	Loamy sand	2	7.4-8.4	Loamy sand	Extends to about 15"	7.4-9.0	Formed on eolian & weathered sandstone
	Cushool	20% of the mapping unit	Occurs on mesa tops		Moderately deep and well drained	Fine sandy loam	5	6.6-8.4	Heavy loam to fine sandy loam to loamy sand	Extends to about 25"	7.4-9.0	"
	Inclusions	15% of the mapping unit										
151D	Ryan Park loamy sand	65 Ac/0.6%	Occurs on alluvial fans and hills	5-15	Deep and somewhat excessively drained	Loamy sand	5	6.6-7.8	Sandy loam to calcareous sand	Extends to 6" or more	6.6-9.0	Formed in material weathered from sandstone

TRACT NAME OR NUMBER: Lay Creek

TABLE 4-3 SOIL LIMITATIONS

Symbol	Name	Available Water Holding Capacity	Rate of Surface Runoff	Undisturbed Erosion Hazard	Erosion Factor K	Erosion Factor T	Surface Wind Erodibility Group	Shrink Swell Potential	Physical Limitations
03B	Havre fine sandy loam	High	Slow	Slight from water and moderate from wind	.28	5	6	Low	The flooding hazard and high corrosivity potential, and low strength are severe limitations for development and limit the use of the two soils for roadfill source material. The Havre silt loam is further limited by salt accumulations and highly alkaline conditions in the profile between 8 and 20 inches which will severely inhibit plant growth is disturbed or brought to the surface and used for topsoil.
03S	Havre siltloam saline	High	Slow	"	.37 surface .28 subsoil	5	5	Moderate on surface low in subsoil	
04A	Glendive loam	High	Slow	Moderate from wind and low from water	.20	5	5	Low	This soil is a fair source for roadfill limited by low strength, flooding potential and shrink swell. This is a fair source for topsoil, limited by the excessive salt content.
7C	Evanston loam	High	Medium	Moderate	.37	5	6	Low to moderate	Fair source for topsoil and roadfill due to clay content and excessive lime which limit is use.

TRACT NAME OR NUMBER: Lay Creek

TABLE 4-3 SOIL LIMITATIONS

Symbol	Name	Available Water Holding Capacity	Rate of Surface Runoff	Undisturbed Erosion Hazard	Erosion Factor K	Erosion Factor T	Surface Wind Erodibility Group	Shrink Swell Potential	Physical Limitations
08B	Brycan clay loam	High	Medium	High from water	.43 surface .37 subsoil	5	3	Low on surface moderate in subsoil	Fair source for topsoil and roadfill due to the thin layer of topsoil, low strength, and shrink swell potential.
23D	Cruckton loamy sand	Low	Slow	High from wind and slight from water	.10	5	2	Low	The wind erosion hazard, low available water holding capacity creating droughty conditions are the most limiting properties of this soil.
26D	Peyton sandy loam	Moderate	Medium	Moderate	.10	5	3	Low	Fair source for topsoil and roadfill but limited by frost action and low strength on slopes greater than 25% sources are greatly limited.
26E	Peyton sandy loam	"	"	"	"	"	"	"	
28D	Forelle loam	High	Medium	Moderate to high	.28-.32	5	3,6	Low to moderate	Fair source for roadfill due to low strength but good source of topsoil below 10% slopes, slopes becoming limiting for use as topsoil above 15 percent.
28E	Forelle loam	"	"	"					
31E	Busby sandy loam	High	Medium	High from wind and moderate from water	.10 surface .17 subsoil	5	2	Low	Fair source for roadfill due to low strength and good source for topsoil on slopes less then 8% but poor source for topsoil on slopes >15%

TRACT NAME OR NUMBER: Lay Creek

TABLE 4-3 SOIL LIMITATIONS

Symbol	Name	Available Water Holding Capacity	Rate of Surface Runoff	Undisturbed Erosion Hazard	Erosion Factor K	Erosion Factor T	Surface Wind Erodibility Group	Shrink Swell Potential	Physical Limitations
32D	Yamac loam	High	Medium	Moderate	.37	5	5	Low	Good source for topsoil on slopes less than 8% but poor on slopes above 15%. Fair for roadfill due to frost action and low strength.
32E	"	"	"	"					
33D	Pinelli loam	High	Medium	Moderate	.32 surface .37 subsoil	5	6	Low on surface to high in subsoil	Poor source to topsoil due to the thin layer and fair for roadfill due to low strength and shrink swell.
35C	Tisworth sandy loam	High	Medium	Moderate from wind and high from water	.32 surface .49 subsoil	5	3	Low on surface moderate in subsoil	Fair source for roadfill, limited by low strength, but poor source for topsoil due to excessive salts and sodium in the subsoil.
39C	Hereford sandy loam	Moderate	Medium	Slight	.15 surface .24 subsoil	5	3	Low	Good source for topsoil on slopes less than 15 percent, fair source for roadfill due to low strength of the fine textures.
47D	Pinelli clay loam	Moderate	Medium	Low from wind and moderate from water	.30 surface	5	4	Low on surface moderate in subsoil	Poor source for roadfill and topsoil due to the excess fines, too clayey.
47D	"	"	"		.37-.28 subsoil	1			

TRACT NAME OR NUMBER: Lay Creek

TABLE 4-3 SOIL LIMITATIONS

Symbol	Name	Available Water Holding Capacity	Rate of Surface Runoff	Undisturbed Erosion Hazard	Erosion Factor K	Erosion Factor T	Surface Wind Erodibility Group	Shrink Swell Potential	Physical Limitations
52D	Cushool fine sandy loam	Low	Medium	Moderate from wind and water	.24 surface	3	3	Low	Poor source for roadfill and topsoil due to thin layer of topsoil and slopes greater than 15%.
52E	"	"	"	"	.28 subsoil	"	"	"	
54E	Yetull loamy sand	Low	Slow	High from wind and low from water	.10	5	3	Low	Good source for roadfill below 15% slopes, fair on greater slopes. Fair topsoil on slopes less than 15% on slopes greater than 15% also limited because it is too sandy.
56D	Zeona loamy sand	Low	Slow	High from wind and moderate from water	.17 surface .10 subsoil	5	2	Low	Poor source for topsoil, too sandy, but good source for roadfill.
58D	Bulkley silty clay loam	High	Rapid	Moderate from wind and high from water	.24	5	4L	High	Highly calcareous shale parent material will be restrictive to plant growth if brought to the surface. Poor topsoil and roadfill due to high clay content.
62D	Rock River sandy loam	Moderate	Medium	Moderate	.20 surface	5	3	Low	Low strength and excessive fine limit the use of this soil for roadfill and topsoil.
62E	Rock River sandy loam	"	Rapid	Moderate from wind and high from water	.24 subsoil	"	"		

TRACT NAME OR NUMBER: Lay Creek

TABLE 4-3 SOIL LIMITATIONS

Symbol	Name	Available Water Holding Capacity	Rate of Surface Runoff	Undisturbed Erosion Hazard	Erosion Factor K	Erosion Factor T	Surface Wind Erodibility Group	Shrink Swell Potential	Physical Limitations
66D	Relsob sandy loam	Low	Slow	Slight from water and moderate from wind	.28 surface .10 subsoil	5	3	Low	Fair source for topsoil and road due to excessive fines.
X66	Relsob-Unnamed sandy loam								Heavy subsoil with excessive lime and salts limit the use of this soil for topsoil and roadfill.
	Relsob	Low	Slow	Slight from water and moderate from wind	.28 surface .10 subsoil	5	3	Low	
	Unnamed X66	High	Slow			"	"	Low	
67	Relsob-Gretdid sandy loam								Good source for roadfill on slopes less than 15% but fair on slopes greater than 15%. Poor source for topsoil due to high sand content and excessive salts in subsoil which create droughty conditions for revegetation.
	Relsob	Low	Slow	Slight from water & moderate from wind	.28 surface .10 subsoil	5	3	Low	
	Gretdid	Low	Slow	High from wind and moderate from water	.15 surface .17-.10 subsoil	"	"	Low to moderate	

TRACT NAME OR NUMBER: Lay Creek

TABLE 4-3 SOIL LIMITATIONS

Symbol	Name	Available Water Holding Capacity	Rate of Surface Runoff	Undisturbed Erosion Hazard	Erosion Factor K	Erosion Factor T	Surface Wind Erodibility Group	Shrink Swell Potential	Physical Limitations
69	Homelake loam	High	Very slow	Low for wind and water	.24	5	5	Low	Water table at approximately 25 inches.
101	Torriorthents-Rock outcrop								Shallow undeveloped soil and barren rock, very steep, very shallow has severe limitations for any use.
	Torriorthents	Low	Moderate to rapid	High	—	1	High	Low to high	
	Rockoutcrop	Very low	Very rapid	Low	—	—			
105	Kemmerer-Moyerson silty clay loam								This complex is a poor source for roadfill and topsoil due to the shallow depth of topsoil, fine textures, highly calcareous and restrictive pH values, and slopes in excess of 25% and rapid surface runoff. Moyerson also contains excessive sodium.
	Kemmerer	Low	Rapid	Slight from wind and low from water	.32	3	4L	High	
	Moyerson	Low	Rapid	High	.28	1	4,4L	High	
110E	Kemmerer silty clay loam	Low	Rapid	Slight from wind and moderate from water	.32	3	4L	High	This soil is a por source for roadfill and topsoil due to the excessive fine textures, highly calcareous and restrictive pH values and steep slopes.

TRACT NAME OR NUMBER: Lay Creek

TABLE 4-3 SOIL LIMITATIONS

Symbol	Name	Available Water Holding Capacity	Rate of Surface Runoff	Undisturbed Erosion Hazard	Erosion Factor K	Erosion Factor T	Surface Wind Erodibility Group	Shrink Swell Potential	Physical Limitations
X110	Kemmerer-Yamac complex			Slight, from wind and water and moderate from water					Kemmerer soil is a poor source for roadfill and topsoil due to excessive fines (heavy clay), highly calcareous, restrictive pH value and steep slopes. Yamac soil is a good source for topsoil on slopes less than 8% but poor on slopes above 15%, fair for roadfill material due to frost action and low strength.
	Kemmerer	Low	High		.32	3	4L	High	
	Yamac	High	Low		.32 surface .37 subsoil	5	5	Low	
115	Yetull-Unnamed Lithic Torriorthents complex very steep								This soil is a fair source for roadfill on slopes less than 25% and has severe limitations on slopes greater than that. This soil is a poor source for topsoil limited by small stone and very calcareous and sandy and steep slopes. The unnamed soil is further limited by the shallow layer of topsoil.
	Yetull	Low	Medium	High from wind and low from water	.10	5	3	Very low	
	Unnamed	Low	Medium	"	.10	5	3	Very low	

TRACT NAME OR NUMBER: Lay Creek

TABLE 4-3 SOIL LIMITATIONS

Symbol	Name	Available Water Holding Capacity	Rate of Surface Runoff	Undisturbed Erosion Hazard	Erosion Factor K	Erosion Factor T	Surface Wind Erodibility Group	Shrink Swell Potential	Physical Limitations
116	Grieves-Lithic Torriorthents-Cushool complex								Slope is the greatest limiting factor. Fair source for roadfill but poor source on slopes greater than 15 percent. Poor source for topsoil due to thin layer of topsoil and steep slopes.
	Grieves	Low	Medium	Moderate	.15 surface .37 subsoil	5	2	Low	
	Lithic Torriorthent	Very low	Medium	High from wind and low from water	.10	5	3	Very low	
	Cushool	Low	Medium	Moderate from wind and water	.24 surface .28 subsoil	3	3	Low	
151D	Ryan Park loamy sand	Low	Slow	Moderate from wind and slight from water.	.32 surface .24 subsoil	5	2	Low	Wind erosion hazard and droughthiness of the soil are severe limitations for revegetation of disturbed areas. Fair source for topsoil due to small stones, slope and very sandy.

4.2 Environmental Consequences

Surface mining on this tract would disturb 1650 acres. In addition, 416 acres would be disturbed by construction of mine facilities, haul roads and topsoil and spoil storage sites. By the end of the mine life, 2066 acres would be disturbed through these activities (Map 2) because of overburden removal and mechanical handling of the topsoil.

Seventy-five percent of the area to be disturbed by mining is covered by soils that would provide a suitable source of plant growth media. These soils units include 08B, 7C, 26D, 28D, 32E, 33D, 52D, 52E, 62D, 62E, X66, 67, X110. These soils are moderately deep to deep loams, loamy sands, and clay loams with physical and chemical properties that are generally suited for revegetation (USDI, 1981). Because of the disturbance configuration (Map 3), wind pattern toography, low precipitation and basically sandy nature of soils, approximately 70-80% of the area has potential for wind erosion. Wind erosion is not normally a problem, and is not addressed in reclamation plans. Measures to correct the loss on the natural wind sheltering would need to be addressed in the reclamation plan for the Lay Creek Tract. The Lay Creek Study Area Report No. 20 (USDI, 1981) discusses surface protection from wind erosion on this tract.

Twenty-five percent of the disturbance area would involve disturbing soils that have limiting characteristics, which would include one or more of the following: contain excessive salts and/or sodium, occur on steep slopes, have heavy clay soils and subsoils, or are shallow and stony. The soils with these characteristics are listed in Table 4-4. These soils, which currently produce limited amounts of vegetation, would be limiting sources of topsoil for

reclamation purposes (USDI, 1981).

TABLE 4-4

LAY CREEK: SOILS WITH LIMITING CHARACTERISTICS FOR RECLAMATION

Mapping Unit	Shallow	Steep Slopes	Clayey Soils	Excess Salts	Acres of Disturbance	% Disturbed
35C				x	40	2
101	x				239	12
105	x	x	x	x	100	5
110E			x	x	80	4
115	x				40	2
	379 1/	100	180	220	499 2/	25 3/
	18%	5%	9%	11%		

1/ Represents acres considered one limitation, contains overlap.
2/ Represents acres without overlap.
3/ Numbers are rounded.

The heavy clay soils that are infertile, have sticky, plastic properties and a hard columnar structure would inhibit seedling emergency during the revegetation process. A common practice in handling this material is not to incorporate it into the topsoil piles during the removal process.

Those areas which have excessive salts and/or sodium would not support good plant growth (USDI, 1981). These soils, listed in Table 4-4, would have to be buried below the rooting zone or leached of soluble salts and sodium. Burying these soils would be the most feasible, but would require borrowing of soils from areas where suitable soils exist, to compensate for them.

Shallow soils and soils on steep slopes, Table 4-4, would be limiting because of quantity, but not necessarily because of quality. These soils, unless they contain salts and/or sodium, or heavy clay, could be used in the reclamation process, with the addition of borrowed soils, after the slopes were

recontoured and traversible by farm equipment. It should be noted that 83 acres of soils unit 101 (Table 4-4 and Section 13 Land Use) are truncated as a result of agricultural practices. This means that disutrbance, to a depth of approximately 12", has occurred; therefore, natural soil profile to this depth has already been lost. Because of this agricultural practice, it may be assumed that soils are not a limiting factor in production.

Sufficient quantities of soils (including subsoil) exist to meet the borrowing demand from suitable soils. Information from the Lay Creek Study (USDI, 1981) indicated that an opportunity does exist to successfully revegetate and reclaim surface mined areas on the tract, by borrowing suitable plant growth media from areas of deep soils. The overburden material has either limited suitability or is unsuitable, because of excessive salts and/or sodium, for use as plant growth media (USDI, 1981). It would therefore be necessary to cover raw overburden with suitable plant growth media during reclamation.

Disturbance, through the topsoil handling and overburden removal, could result in the alteration of productivity, by mixing soils, loss of soil profiles, and creation of more homogenous textured soils. Also, changes in numbers and diversity of the soil microbiota could alter the nutrient-energy cycling, which has a large influence in soil fertility. This concern has not been documented in northwest Colorado.

Because of regulations requiring same or better productivity than before mining, and adequate and suitable plant growth media, impacts to soils would be mitigated, except for the destruction of the soil physical profile.

Concerns of excessive salts, sodium, and wind erosion potential would need to be addressed in any reclamation plan that may be submitted for this tract. These concerns would increase the cost of reclamation and the size of the reclamation bond.

4.2.2 Short Term vs. Long Term Productivity

All of the disturbed area would be returned to a productive state at the end of the mine life.

4.2.3 Irreversible and Irretrievable Commitment of Resources

See Attachment 2A.

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Attachment 2A

THE SITE SPECIFIC ANALYSIS

Tract Name or Number: Lay Tract

State: Colorado

Leasing/Development Scenario: #1 Surface Mine

Resource Element	Committed Mitigation	Anticipated Impact Baseline (1985)	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Prime and unique famlands	USDA, SCS Public Law 45-87 Section 657.5	Unknown	⟶	⟶	⟶	⟶	Good SCS, Moffat Co. Survey Reports	None	None
Soils Erosion potential	Federal (OSM, SMCRA), state (CMLRB), and local reclamation regulations	3-5 tons/ac/yr	116 Ac	311 Ac	636 Ac	2066 Ac	Good, the Universal Soil Loss Equation	The increased erosion rate of 15-20 tons/ac/yr would be irretrievably displaced by wind and water erosion.	Disturbed and unprotected soils would be moderately susceptible to wind erosion. Discussion of wind erosion and surface protection may be found in Lay Creek Study #20 (USDI, 1981). This impact may be lessened by the enforcement of reclamation regulations Insignificant impact

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Tract

State: Colorado

Leasing/Development Scenario: #1 Surface Mine

Resource Element	Committed Mitigation	Anticipated Impact Baseline (1985)	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Chemical limitations	Federal (OSM, SMCRA), state (CMLRB) and local reclamation regulations	Good except for soluble salts in the profile of the soils Table 4-4. Poor overburden due to high sodium and soluble salt content.	14 Ac	37 Ac	76 Ac	220 Ac	Good		See Table 4-4 and text. Chemical limitations may be encountered by stockpiling topsoil, but these limitations can be overcome by the application of organic fertilizers, shortening the period of stockpiling and inoculation of adapted strains of microbiota.

Attachment 2A

THE SITE SPECIFIC ANALYSIS

Tract Name or Number: Lay Tract

State: Colorado

Leasing/Development Scenario: #1 Surface Mine

Resource Element	Committed Mitigation	Anticipated Impact					Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
		Baseline (1985)	1992	1995	2000	EML			
Physical limitations	Public Law 95-87 Federal (OSM, SMCRA), state (CMLRB) and local reclamation regulations	Steep slopes and shallow topsoil. 23% of disturbed area.	39 Ac	106 Ac	216 Ac	479 Ac	Good, SCS Moffat County Soil Survey report		Mechanical means of amending the steep slopes to farm equipment would be required to stabilize the slopes and to complete the revegetation process. Sufficient topsoil is available for the shallow areas from the deeper areas. Steep slope and shallow soils (see Table 4-4).

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Tract

State: Colorado

Leasing/Development Scenario: #1 Surface Mine

Resource Element	Committed Mitigation	Anticipated Impact: Baseline (1985)	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Physical profile	None	Developed soil horizons and functioning nutrient-energy cycling	116 Ac	311 Ac	636 Ac	2066 Ac	Good, SCS Moffat County Soil Survey reports	Complete change of the soil profile and introduction of new parent material would result in an alteration of diversity and creation of new soils with altered physical properties of soil structure, texture, permeability, infiltration rates, effective rooting depths, microclimate and nutrient and energy cycling.	Avoid mixing of the soil horizons and keep topsoil separate from the subsoil and overburden. Insignificant impact

Tract Name or Number: Williams Fork

State: Colorado

Leasing/Development Scenario: #1 Surface Mine

Resource Element	Committed Mitigation	Anticipated Impact: Baseline (1985)	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Suitability as plant growth media	Federal (OSM, SMCRA), state (CMLRB) and local reclamation regulations	Fair to good; some heavy clay subsoils and shallow topsoil less than 12 inches thick	0 Ac	0 Ac	0 Ac	0 Ac	Good; SCS Moffat County Soil Survey report; USDI, 1981		One way to alleviate the problem of the fine textured subsoil is to avoid mixing it with the topsoil during the removal process. See text and Table 4-4.
Availability of plant growth media	Federal (OSM, SMCRA), state (CMLRB) and local reclamation regulations	Adequate	0 Ac	0 Ac	0 Ac	0 Ac	Good SCS Moffat County Soil Survey report and USDI, 1981		Topsoil & subsoil in adequate quantities to allow borrowing to replace soils with limitations

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Tract

State: Colorado

Leasing/Development Scenario: #1 Surface Mine

Resource Element	Committed Mitigation	Anticipated Impact: Baseline (1985)	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Occurrence of toxic elements	Federal (OSM, SMCRA), state (CMLRB) and local reclamation regulations	Unknown	Number of acres affected to a toxic level is unknown.	——→	——→	——→	Good, USDI 1981.		Any toxic elements encountered would need to be buried below the rooting zone.
Land use planning stips.	None	None	——→	——→	——→	——→	Good	None	None
Proposed mitigation	Federal (OSM, SMCRA), state (CMLRB) and local reclamation regulations	None	——→	——→	——→	——→	Good	None	Reclamation regulations

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Tract

State: Colorado

Leasing/Development Scenario: #1 Surface Mine

Resource Element	Committed Mitigation	Anticipated Impact Baseline	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Reclamation regulations									
Potentials back to present use	Federal (OSM, SMCRA), state (CMLRB) and local reclamation regulations	Fair	0	——>	——>	——>	Good; Little Snake Resource Area Natural Resource Specialists		Large areas of disturbance and reclamation has not occurred in the area for comparison purposes.
Potential back to other uses	"	Dryland farming and livestock grazing	Unknown	——>	——>	——>	Good		Dryland farming is a potential use following reclamation.

53

5. Water

5.1 Affected Environment

5.1.1 Surface Water

Lay Creek, which flows southwestward across the central part of the tract, is an intermittent stream that generally has standing pools of water along its course throughout the summer. All other streams draining the tract are ephemeral. Lay Creek and its principal tributary, Bord Gulch, have channel gradients of about feet per mile (40 ft/mi). Channel gradients of other streams are typically steep, averaging 250 to 500 ft/mi.

Annual runoff from the tract probably does not exceed 0.5 inch or about 500 acre-feet. Maximum discharge of Lay Creek in response to 10, 50 and 100-year floods is estimated to be 700, 1350 and 1700 cubic feet per second (cfs), respectively. Maximum discharge of other streams on the tract should not exceed 200 cfs in a 100-year flood.

Seasonal water for livestock and wildlife is provided by 24 small reservoirs (BLM, 1979). Most reservoirs have less than 10 acre-feet capacity with some reservoirs in the higher elevations dry and those along Lay Creek maintaining a near full level in September 1982 at the time of the field examination. Surface runoff from the tract contains 500-1000 milligrams per liter (mg/l) dissolved solids and is a calcium, magnesium, sulfate type--a good quality water for livestock and wildlife (BLM, 1979). State of Colorado records

indicate that there are no water rights filings within the tract for either surface or ground water.

5.1.2 Groundwater

Ground water on tract occurs under confined and unconfined conditions in permeable coal and sandstones of the Fort Union Formation and under unconfined conditions in alluvial sand and gravel aquifers (BLM 1978-1981). Perched water tables may exist in the tract above the main water table. This type of water table occurs in permeable strata overlying an impervius layer (shale or mudstone). The presence or extent of perched water in the tract is not known.

Steep hydraulic gradients of 100 to 200 feet per mile, coupled with an absence of any springs on or adjacent to the tract indicates that ground water discharge from the tract is less than 25 gallons per minute (BLM, 1979). The potentiometric surfaces of the individual aquifers are graded to the principal stream valleys that traverse the tract; therefore, all permeable rocks can be assumed to be saturated below the level of these valley floors, whereas they tend to be drained to a depth of several hundred feet along the higher elevations that form the ridge tops.

The Fort Union Formation supplies water to four wells used for livestock watering. The alluvial aquifer supplies water to one irrigation well in Bord Gulch and to one domestic well in Lay Creek Valley. Elsewhere on tract, the alluvial aquifer is not being used. Data for all wells in and adjacent to the tract are summarized in Table 5-1 (BLM 1978-81). Water rights have been

TABLE 5-1

DATA FOR WELLS IN THE VICINITY OF LAY TRACT[A]

No.	Location 1/	Depth (feet)	Depth of Static Water Level (feet)	Aquifer	Transmissivity (ft/day)	Specific Conductance (umhos/cm)	Dissolved Solids 2/ (mg/1)	pH	Use
1	7-94-9 CDC	187	120.9	Tfu 3/	--	--	--	--	Livestock
2	7-94-10 DAA	--	--	Tfu	--	1800	1300	--	Livestock
3	7-94-11 CAA	153+	153+	Tfu	--	--	--	--	Livestock (not used)
4	8-93-20 CDD	44	14.39	Qal 4/	--	250	180	7.25	Unused (no pump)
5	8-93-27 ACD	165	--	--	--	--	--	--	Dry Hole
6	8-93-29 ACC	500+	3.80	Tfu	--	850	600	8.35	Observation Well
7	8-93-29 BAC	80	--	Qal	3000+	1000	700	7.05	Irrigation
8	8-93-30 DCA	430	97.69	Tfu	46	1100	770	8.3	Observation Well
9	8-93-30 DCB	400	76.10	Tfu	31	1650	1200	8.4	Observation Well
10	8-93-32 AAA	30	--	Qal	--	450	320	--	Domestic
11	8-93-32 CDC 6/	--	Flows 5/	Tfu	--	2050	1400	8.7	Livestock
12	8-94-25 DCC	600	52.24	Tfu	22	2000	1400	7.6	Observation Well
13	8-93-29 BB 7/								Irrigation
14	8-93-29 AA 7/								Stock

A (BLM, 1979)
1/ Refers to standard USGS well-numbering system
2/ Approximate value obtained by multiplying specific conductance by 0.7
3/ Tfu, Fort Union Formation
4/ Qal, alluvium
5/ Well flows less than 0.5 gal/min
6/ Water rights filed (since 1979 SSA)
7/ Well not identified in 1979 SSA, water rights have been filed.

filed on three wells within the tract. Two of the filings (numbers 11 and 13) are located on private surface/private minerals along Bord Gulch and Lay Creek respectively. The other well filed on is number 14 and is located along a west flowing tributary to Bord Gulch.

Chemical analyses indicate that water in the coal and sandstones of the Fort Union Formation contains about 900 to 1500 mg/l of dissolved solids and is a sodium bicarbonate or sodium sulfate type with lesser amounts of calcium and magnesium.

Water in the alluvium contains about 200 to 700 mg/l of dissolved solids and is a calcium bicarbonate type.

5.1.3 Erosion and Sedimentation

Erosion is most pronounced on south-facing slopes where steep gradients, a sparse plant cover, and gullied channels indicate sediment yields in excess of 2 acre-feet per square mile per year (ac-ft/sq mi/yr). The north-facing dipslope surface that comprises the bulk of the tract is comparatively stable, but some actively eroding channels, up to 10 feet deep attest to appreciable local erosion. Annual sediment yield from this part of the tract probably averages 0.3 to 0.5 ac-ft/sq mi/yr. The average for the overall tract is estimated to be about 0.8 ac-ft/sq mi/yr.

Most of the sediment eroded from the tract is deposited in reservoirs and on the bottoms of Bord Gulch and Lay Creek. Most of these reservoirs have little or no remaining capacity to store water.

5.1.4 Alluvial Valley Floors

The lower reach of Bord Gulch and the bottom of Lay Creek for at least a mile upstream and downstream from the mouth of Bord Gulch are alluvial valley floors (AVF) as defined in Public Law 95-87. Both subirrigation and flood water irrigation are occurring in these valley reaches. Water in the alluvium at the upper end of these alluvial valley floors contains less than 500 mg/l dissolved solids. Water in pools in the channel of Lay Creek at the downstream end of the subirrigated area contains about 2100 mg/l dissolved solids.

The alluvial valley floor of Bord Gulch may be recharged by ground water from the proposed mine area located in T. 8 N., R. 93 W., Sections 29 and 30. The degree of hydrologic interconnection and bedrock discharge to the AVF is not known. Leaching of this spoils aquifer could increase TDS levels by as much as 1500 mg/l, but is not expected to increase downstream TDS levels significantly because of the present high concentrations.

A general analysis can be made based on studies that evaluated the effects of elevated TDS waters discharging from mined areas on the surrounding ground water systems. These studies used a plume model and concluded that elevated TDS were diluted back to baseline levels within 2600 to 7000 feet from the spoil water source (Bishop and others, 1982).

Groundwater movement from the spoils aquifers is anticipated to be down dip (to the north in the east half of the tract, and northwest in the west half of

the tract) because the pit base would act as an impervious layer and cause water to move down dip. TDS levels of affluent groundwater to Lay Creek's AVF (north and northwest of eastern pit) is expected to be diluted to near background levels.

Leaching of the spoils aquifer could increase dissolved solids by as much as 1500 mg/1, but is not expected to increase downstream TDS levels significantly because of the present high concentrations.

Since this area is encompassed by the area unsuitable for surface disturbance because of floodplains (Section 5.1.5), no impacts to these alluvial valley floors would occur as a result of surface disturbance.

If additional information proves contrary to the previous statement special performance standards found in 30 CFR Part 822 will apply during mining activity.

5.1.5 Floodplains

The Williams Fork Management Plan Coal Amendment 1979, has identified two floodplains within the boundary of the Lay tract unsuitable for disturbances related to mining. These are adjacent and parallel to Bord Gulch and Lay Creek.

A floodplain is defined as any land area susceptible to being flood inundated from any source, including small and often dry water sources. Small water

courses can become sources of major flood damage runoff from intense rainstorms or rapidly melting snow.

Lay Creek and Bord Gulch are unsuitable for surface mining. Delineation of these floodplains can be determined with present information as follows: those areas inundated by the 100 year flood peak stage (1700 cfs), in and paralleling the mainstream bottoms and those areas 200 feet adjacent to each bank of the mainstream channels in Lay Creek, Section 21, Lots 5 to 8 and Section 22, N 1/2 SW 1/4 SW 1/4; Section 32, Lots 1, 4, 6, 10 and 15, T. 8 N., R. 93 W.; Bord Gulch, Section 20, Lot 2, Section 29, Lot 1, 10, T. 8 N., R. 93 W. Mineable coal may exist below the floodplains, but were not included in calculations of coal resources or areas potentially mineable.

The following stipulation would apply to the above described area: no surface occupancy or disturbance related to mining activity. Therefore, no impacts are expected.

5.2 Environmental Consequencs

5.2.1 Surface Water

Impacts to the surface water systems in and adjacent to the tract as a result of mining operations are expected to be minor. Projected surface runoff from the tract to Lay Creek is expected to be reduced by less than 20 percent (100 ac-ft/yr) during peak production and would return to approximately premining rates on completion of reclamation (BLM, 1979).

Approximately four of the twenty-four reservoirs are expected to be removed by mining operations. The removal of these reservoirs is considered insignificant, since stock and wildlife would be displaced from the mine area. Runoff is expected to contain less than 1,000 mg/l TDS and should have no significant impact on downstream aquatic biology. Peak discharges in the mined area are not expected to present significant flooding hazards.

5.2.2 Ground Water

Moderate inflow to the pit is expected almost from the outset of mining, and appreciable inflow should occur after mining progresses downslope to greater depths below the surface. If inflow could exceed the consumptive use of water in the mining operations, a National Pollutant Discharge Elimination System (NPDES) permit will be required for the discharge of excess mine water and may require treatment prior to being discharged into existing streams.

On completion of mining and reclamation, ground water discharge should return to at least premining rates, but leaching of spoil materials may increase the dissolved solids concentration from about 1000 mg/l before mining to about 2500 mg/l after mining. If Lay Creek and Bord Gulch receive affluent groundwater from the mine areas, the TDS levels should be attenuated to a lower level than originally in the spoils aquifer (see Section 5.1.4). Because ground water and surface water in the lower reaches of Lay Creek already contains in excess of 2000 mg/l dissolved solids it appears unlikely that mining on the Lay tract would increase the salinity of the Yampa or Colorado rivers (BLM, 1979).

Wells completed in the reclaimed mine areas may be up to 200 feet deeper, because perched water tables, that may have been present in the overburden (prior to mining), have been replaced with backfilled spoils. The spoils aquifer would lack confining layers and develop a water tabyle that may be much deeper than a premining perched water table.

The effects of mining on wells located in and adjacent to the tract (Table 5-1) are discussed below. Wells 1, 2, 3, 6, and 11 are not expected to be impacted, since they are located up dip from proposed mining areas. Wells 4 and 14 will not be impacted because they have been stratigraphically and hydrologically truncated by Lay Creek and Bord Gulch from proposed mining areas to the east and west.

Well 7 could have elevated TDS levels as a direct result of mining if there is hydrologic connection and eastward groundwater flow from bedrock aquifers adjacent and lateral to the mine (T. 8 N., R. 93 W., Sections 29 and 30) to Bord Bulch AVF. The worst-case estimate of TDS increase to the well would be about 2500 mg/l (original ground water = 1,000 mg/l + leached from spoils 1500 mg/l, with no decrease in TDS levels during flow to well). Actually this estimate is too high, since original and leached TDS values are not known and TDS levels are normally decreased during ground water flow by dilution, dispersion, and chemical activity (precipitation, adsorption, and absorbtion).

Wells 8, 9, and 12 are observation wells located down dip (northwest) from proposed mining in the western portion of the tract. Groundwater flow into lateral aquifers from the spoils aquifer may result in elevated TDS levels in

these wells. There may also be a decrease in recharge to these wells during and shortly after mining until the water table is reestablished. The degree that these wells are affected is dependent upon the existence of hydrologic connection and the capability of the groundwater system to attenuate TDS levels. The worst-case estimate for these wells is the same as for well 7.

Well 13 is an irrigation well in Bord Gulch AVF about one-half mile north of the proposed mine in T. 8 N., R. 93 W., Sections 29 and 30. Well 13 should not be affected because the groundwater flow in the alluvium of Bord Gulch is to the south.

Well 10 is the only domestic well known in or near the tract. The wells is located in the Lay Creek AVF about one-half mile upstream from the confluence of Bord Gulch and Lay Creek. The only possible source of contamination to this well is from the mining area in T. 8 N., R. 93 W., Sections 25, 26 and 27. The worst-case contamination would be about the same as for well 7. The well is located over one and one-quarter mile west-southwest from the nearest mining and ground water flow is essentially down dip to the north in the mine area. These factors suggest that if there is hydrologic connection between the aquifers lateral to the mine and the AVF, that the TDS levels should be attentuated to acceptable levels by the time it reaches the well.

References Cited

Bureau of Land Management, Bureau of Reclamation, and USGS, 1981. Resource and Potential Reclamation Evaluation: Lay Creek Study Area. Report **.20.

Bishop, M., Kelly, K., Kimball, B., and Quinn, G., 1982. Cumulative Hydrologic Assessment: Effects of Coal Mining on the Yampa River Basin, Moffat and Routt Counties, Colorado. Colorado Mined Land Reclamation Division, Dept. of Natural Resource. Rept. KT-81-031 (R).

Bureau of Land Management, 1979. Site Specific Analysis, Lay Creek Tract. Craig District, Colorado.

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: 1

Resource Element	Committed Mitigation	Anticipated Impact: Baseline	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Surface Water Type of occurrence	All stream channels would be reconstructed to state and federal regulations	Lay Creek is intermittent, all others are largely ephemeral	All stream channels disturbed by mining are expected to be in upper reaches of watershed where flows are small	→	→	Disturbed channels would be reconstructed as required	Field observations		Minor and short term disruption. All stream channels would be reconstructed
Quantity	Comply with state and federal requirements	Estimated runoff is about 0.5 inch or about 500 ac-ft annually	Runoff may be reduced up to 100 ac-ft/yr during mining	→	→	Annual runoff should return to near premining condition	Effects of development on surface water are largely inferred without benefit of field observation		

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: 1

Resource Element	Committed Mitigation	Anticipated Impact					Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
		Baseline	1992	1995	2000	EML			
Surface Water Quality	Comply with state and federal water quality requirements	Quality is good for livestock and probably contains less than 1000 mg/l dissolved solids and a calcium magnesium, sulfate type	Increase in dissolved solids no significant effect during mining	——>	——>	Leaching of spoils aquifers after reclamation could increase dissolved solids concentration in base flow by 1500 mg/l	Inferred from previous field measurements of water quality in reservoirs on tract (GR/HF EIS Round 1)	Specific conductance and dissolved solids are expected to increase after mining and remain at a higher butat insignificant level.	
Salinity of receiving waters (Yampa river)	Comply with state and federal water quality standards and NPIES permit	No current salinity problems in Yampa River	Slight increase is expected due to disturbance and mining operations	——>	——>	Spoils aquifer would continue to produce increased levels of salinity over baseline	Inferred from long term leaching of spoils aquifer	Would increase salinity in the Yampa River system	Increased salinity should show no significant impact

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: 1

Resource Element	Committed Mitigation	Anticipated Impact: Baseline	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Surface Water Erosion and sediment action	Comply with state and federal requirements	Tract is moderately stable with yield estimated at 0.8 ac-ft/sq mi/yr	Slight decrease may be expected from sedimentation ponds	———>	———>	Insignificant; long term sediment yield would probably be no more than premining rate	Field observation	None	
Importance to livestock and wildlife	Augmentation plan submitted to the state of Colorado at mine plan stage by mining company	24 reservoirs on tract provide a source of good water	Minimal effect on streams approximately 4 reservoirs would be removed by mining	———>	———>	———>	Field observation and USGS 7 1/2' topographic maps		Very minor disruption, sedimentation ponds could provide alternative source of water during mining. Reservoirs could be reconstructed after reclamation.

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: 1

Resource Element	Committed Mitigation	Anticipated Impact: Baseline	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Surface Water Importance to industry (agriculture)	Augmentation plan submitted to the state of Colorado at mine plan stage by mining company	Runoff from the tract to agricultural areas on bord Gulch and Lay Creek valleys furnishes less than 5 percent of surface water supply	Loss can be as much as 25 ac-ft annually in runoff to valley floors	⟶	⟶	⟶	Inferred from field observations and water rights filings		Insignificant impact. expected to be short term
Importance to people	Type same as above	Surface runoff on tract is not used idrectly for individual or municipal supplies	None	⟶	⟶	⟶	Inferred from field observations and water rights filings	None	

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: 1

Resource Element	Committed Mitigation	Anticipated Impact: Baseline	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Ground Water Type of occurrence (aquifers)		Confined in Fort Union Formation and unconfined in alluvium in principal stream valleys.	Bedrock aquifers in mined areas would be replaced with more permeable spoils aquifer, alluvial aquifers probably would not be disturbed	→	→	→	Inferred from geology, topography and wells on and adjacent to tract and field observations	Would require future wells in mined areas to be about 200 feet deeper with correspondingly higher pumping lifts	Suitable wells for livestock and wildlife could be developed on tract after mining

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: 1

Resource Element	Committed Mitigation	Anticipated Impact					Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
		Baseline	1992	1995	2000	EML			
Ground Water Quantity	Comply with state and federal regulations	Total discharge from the tract is probably less than 25 gpm. No known springs or seeps exist on tract.	Well yields may fluctuate in area	——>	——>	Spoils areas should store greater quantities of water though dissolved solids may be higher	Inferred from geology, topography and wells on and adjacent to tract and field observations	Aquifer system on tract would be altered. Yields from spoils aquifer may increase and possible new springs may appear at lower elevations in spoils	Discharge to adjacent valleys could increase slightly following mining. For well locations see Table 5-1.

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: 1

Resource Element	Committed Mitigation	Anticipated Impact: Baseline	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Ground Water Quality	Comply with state and federal regulations	Water in bedrock and alluvium contains 200 to 1500 mg/1 dissolved solids and is probably a calcium, magnesium sulfate type	Slight increase in dissolved solids from mining distur- bance and spoils piles	→	→	Leaching of spoils could increase dissolved solids concentra tions to 2000-3000 mg/1 in spoils aquifer	Inferred from similar operations in northwestern Colorado and field operations of previous water samples on tract		Dissolved solids would increase and continue at such level alhtough level should not have significant effects on usage
Importance to livestock and wildlife	Augmentation plan submitted by mining company to state of Colorado and BLM mine plan stipulations	No stock water wells or springs in proposed mine area	None	→	→	→	Inferred from GR/HF EIS Round 1 and field observations		

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: 1

Resource Element	Committed Mitigation	Anticipated Impact: Baseline	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Ground Water Importance to industry (agriculture)	Augmentation plan submitted to the state of Colorado at mine plan stage by mining company	Irrigation well in Bord Gulch obtains water from alluvium. Subirrigation occurring along Lay Creek.	Dissolved solids would increase by as much as 1500 mg/l where influenced by mining	⟶	⟶	⟶	Inferred from GR/HF EIS Round 1		Bottoms of Bord Gulch and Lay Creek valley are alluvial valley floors

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: 1

Resource Element	Committed Mitigation	Anticipated Impact: Baseline	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Ground Water Importance to people (individual and municipal supplies)	Augmentation plan submitted to the state of Colorado at mine plan stage by mining company	One domestic well obtains water from alluvium in Lay Creek Valley (Table 5-1)	None	———>	———>	Dissolved solids may increase slightly. The amount of increase would depend upon travel time from spoils to alluvium and the amount of dilution from Lay Creek upstream of the well	Field observation and inferred from GR/HF EIS Round 1		

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: 1

Resource Element	Committed Mitigation	Anticipated Impact Baseline	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Alluvial valley floors	PL 85-97 Surface Mining and Reclamation Act 1977	Bottoms of Bord Gulch and Lay Creek and Sections 20, 21, 28, 29, 32	None	→	→	→	Field observation USGS topographic maps		
Floodplains and wetlands	Federal Land Policy Management Act BLM, EO 11998	" (see Section 5.1.5)	None	→	→	→	Field observations, US Army Corps of Engineers USGS topographic maps		

6. Vegetation

6.1 Affected Environment

The vegetation was mapped into ecological subdivisions or range sites, Figure 6-1. The range sites were mapped according to variation of environmental factors and vegetation. Differences in environmental factors, predominantly in climate, soil, and topography result in differences in vegetation (kind, proportion, and production).

There are several different range sites within the tract. Production values are expressed on a dry weight basis. A discussion, as written in the Lay Creek Study Report No. 20, 1978-81, of each of these follows. See Figure 6-1.

Swale Meadow

This site occupies floodplains and terraces of streams. Soils are fine sandy loam to clay loams and may show signs of poor drainage. The fluctuation, duration and height of the water table causes variation in plant growth.

The site indicates a transition between saline meadows and nonsaline grass-shrub communities. Due to past management practices, undesirable species such as greasewood, are invading the site. It is comprised of 28 percent *Sarcobatus vermiculatus* (greasewood), 27 percent *Atriplex* sp. (saltbush), 8 percent *Chrysothamnus* sp. (rabbitbrush) and 7 percent *Artemisia tridentata* (big sagebrush). *Agropyron smithii* (western wheatgrass) makes up

the grass composition, 22 percent, with forbs comprising a minor 6 percent. Annual production was 989 pounds per acre.

Under climax conditions, the vegetation would consist of 90 percent grasses and 10 percent forbs with western wheatgrass being the dominant grass. Potential production would vary between 1500 and 2500 pounds per acre annually dpending on growing conditions of the year. The swale meadow consists of 94.31 acres, or 1% of the tract.

Clayey Foothills

Soils of this site are deep to moderately deep clay or clay loam. Permeability is slow, but the soils have an excellent water storage capability if cover is sufficient to retard runoff. The high wilting point, however, probably offsets any influence of added water storage on the vegetation. The site is found on rolling benchland and north aspects with slopes less than 12 percent. Western wheatgrass and Agropyron riparium (streambank wheatgrass) dominate the composition with 36 percent and 15 percent, respectively. Big sagebrush and rabbitbrush make up 79 percent of the composition, giving the area an open shrub appearance.

Potential vegetation for the site would be comprised of approximately 75 percent grass, 20 percent shrubs, and 5 percent forbs. Production would vary between 600 and 1200 pounds per acre annually depending on the growing conditions of the year. The clayey foothills consist of 527.64 acres, or 5% of the tract.

Alkaline Slopes

This site is found on upland benches with less than 10 percent slopes. Soils of this site are variable but are characterized by poor soil moisture relationship creating a low site potential.

The present vegetation is predominantly forbs which make up 48 percent of the composition. The major grass species, western wheatgrass, accounts for 5 percent of the composition with shrubs, such as big sagebrush, rabbitbrush and Tetradymia sp. (horsebrush) totalling 33 percent. The site produced 401 pounds per acre.

Potential for the site is a brush-grass mixture with each comprising 45 percent of the composition. Total annual production ranges from 400 to 800 pounds per acre. There are 99.13 acres of the alkaline slopes range site on the tract, or 1%.

Deep Loam

One area of deep loam is found on the site. It occupies the upper portions of a drainage system with a deep gully dissecting the site. Soils are deep, well drained, and slowly permeable. Available water-holding capacity is high.

This community type has been depleted due to various past pressures exerted on the vegetation. This is indicated by the invasion of big sagebrush which comprises 76 percent of the composition. Grasses and forbs make up

approximately 22 percent of the composition.

The site has the potential for moderate to high production rates depending on growth conditions of the year. Annual production during the summer of 1979 was 527 pounds per acre, but the site has the capability of producing 900 to 1800 pounds per acre indicating the existing problem of the invasion of undesirables. There is 322.9 acres of the deep loam range site, or 3% of the tract.

Clay Pan

This area is delineated from the surrounding areas due to the vegetative restriction of the hard clay horizon (clay pan) in the soil. It is level to gently sloping and the subsoil is strongly structured and fine textured. The subsoil tends to restrict water permeability and plant moisture availability due to the high swelling characteristics associated with the clays.

The area supports a wide diversity of shrub species resulting in a low appearing shrub dominated community. Rubber rabbitbrush and green rabbitbrush have the highest composition accounting for 70 percent of the total annual production of 864 pounds per acre. Streambank wheatgrass is the dominant grass with 9 percent composition. Shrubs make up 13 percent of the total cover with 47 percent bare soil.

Principal grass species, in a climax state, are Koeleria cristata (prairie junegrass), wheatgrasses and Poa sp. (bluegrasses). The site is dominated

by *Artemisia longiloba* (alkali sagebrush), with rabbitbrush and *Atriplex* sp. (saltbush) also present. The site is treeless with potential production ranging from 300 to 800 pounds per acre annually. There is 116.28 acres of the claypan range sites on the tract, or 1%.

Loamy Breaks

This particular site consists of stony ridges leveling off to gentle cast-facing slopes. The degree of slope ranges from 3 to 25 percent; this influences the moisture retention of the soil. The soils are fairly shallow, medium textured, and classified as loam or stony loam. Permeability is moderate; but due to the steepness of the topography, plant moisture efficiency is reduced.

Big sagebrush dominates the site making up 58 percent of the total composition, along with nearly 8 percent green rabbitbrush. Western wheatgrass, streambank wheatgrass, *Stipa comata* (needle and thread), and junegrass suport the major grass community, making up approximately 12 percent of the composition. Forbs make up 17 percent composition, resulting in 697 pounds of forage produced per acre.

The potential production for this site varies from 400 to 80 pounds per acre annually depending on the climatic factors of that particular year. Composition under climax conditions could total as much as 48 percent grasses, 7 percent forbs, and 45 percent shrubs. There are 766.03 acres of the loamy breaks range site on the tract, or 8%.

Clayey Slopes

Topography of this site is steep and hilly with slopes ranging from 15 to 65 percent. The site occupies foothill ridge crests and side slopes with soil varying from moderately deep to shallow. Soils are well drained, have slow permeability, and low available water capacity.

The clayey slopes site is dominated by 27 percent big sagebrush. The grass community comprises nearly 50 percent of the composition with the major grass species being western wheatgrass, streambank wheatgrass, bluebunch wheatgrass, and needle and thread grass. Forbs make up nearly 12 percent of the composition.

Another area classified as clayey slopes is rated in poor condition, and supports such brush species as big sagebrush, green rabbitbrush, and *Eurotia lanata* (winterfat) to make up 45 percent of the composition. With this increase in brush vegetation, competition between species increased, leaving only 9 percent grasses within this vegetational pattern. The major grass species is streambank wheatgrass followed by western wheatgrass. Forbs production was high, accounting for 43 percent of the production.

The potential for the clayey slope range site ranges from 400 to 800 pounds per acre annually, depending on growth conditions of the year. The native grasses, including western and bluebunch wheatgrass, junegrass, and *Sitanion hystrix* (squirreltail) make up 45 percent of the composition. Big sagebrush, *Atriplex confertifolia* (shadscale), and *Atriplex* species would make up the

shrub communities intermixed with approximately 10 percent forbs. There are 917.19 acres of the clayey slopes range site on the tract, 9%.

Foothill Swale

The soils are deep, well drained, and moderately coarse textured, the soil has good permeability with a high intake rate and a moderately high water-holding capacity. Due to previous management, the site has deteriorated to a shrub-dominated community producing one-third to one-half of its potential.

This valley grassland community now supports sparse vegetation including such species as western wheatgrass, Stipa lettermanii (letterman needlegrass), green rabbitbrush, and big sage. Grasses make up nearly 21 percent of the composition with shrubs and forbs at 70 percent and 9 percent, respectively. Annual production was equivalent to 873 pounds per acre.

The climax state of this site produces from 1000 to 3000 pounds per acre annually which is a primary factor separating this subdivision from other sites. Grasses should be the dominant cover for this site, including such species as western wheatgrass, streambank wheatgrass, wildrye, squirreltail, bluegrasses, and needle and thread representing 70 percent of the composition. Big sage is also present. There are 543.82 acres of the foothill swale site on the tract, or 5%.

Sandy Foothills

The sandy foothills area occurs as gently rolling hills. Soils are sandy loams to loamy sand. Water-holding capacity is low due to the sand content, but it does take water rapidly making it favorable for certain flora. Permeability is moderate, with surface runoff slow. Erosion hazard is moderate to high under deteriorated conditions.

Present vegetation is characteristic of a sagebrush-grass type community. Big sagebrush is the dominant vegetation, having a composition of 21 percent. Streambank wheatgrass is the most frequently occurring grass, totalling 12 percent composition, followed by other grasses such as bluegrass, junegrass, bluebunch wheatgrass, and western wheatgrass listed in respective order. Total annual production was considered below potential for this site at 559 pounds per acre.

The potential for this site is moderately high for the area in which it is located. During favorable years, production may be as high as 1200 pounds per acre with a minimum production of 600 pounds per acre. Grasses such as western wheatgrass, streambank wheatgrass, basin wildrye, Oryzopsis hymenoides (Indian ricegrass), bluegrass and needle and thread are most likely to inhabit this type of community under climax conditions. Shrubs should only account for 15 percent of the composition. There are 391.98 acres of the sandy foothills site on the tract, or 4%.

Rolling Loam

The rolling loam site, which was rated in good condition, accounts for a large portion of the tarct. The are rated in poor condition is located in the eastern portion and lies above clayey slopes. The soils are a deep, well drained series having slow permeability and high water-holding capacity.

The vegetation on each classified site varies greatly due to past management practices. The portion, which was rated in good condition, has a high percentge of grasses and forbs accounting for 80 percent of the vegetation. On the other hand, the site in poor condition has approximately 72 percent shrubs which have had a direct competitive impact on more desirable species. Streambank wheatgrass and western wheatgrass are the most common grasses encountered on these sites. Big sagebrush was the most common shrub, with certain Astragalus sp. (locoweeds) inhabiting the more favorable locations within the area. Present production for good and poor conditioned sites totalled 671 pounds per acre and 993 pounds per acre, respectively. The increased annual production for the poorer site is due to the biomass of shrubs in relation to that of grasses.

Climax vegetation is that of an open stand of sagebrush with an abundance of grasses, 75 percent composition, such as bluebunch wheatgrass, junegrass, squirreltail, and needle and thread. Potential production ranges from 500 to 1000 pounds per acre annually. There are 3987.56 acres of the rolling loam site on tract. This is 40% of the tract.

Stony Foothills

This area includes strongly sloping to very steep topography. Soils are medium textured, rocky, with deep to shallow subsoils. The soils are well drained, moderately permeable, but generally have a low available water holding capacity. Associated with the steep slopes is a high water erosion hazard in the absence of vegetative cover. This range site was divided into different categories based on its present condition. In one instance juniper is present comprising 91 percent of the total composition, while the other subdivision supports 62 percent juniper. This 91 percent tree composition affects grass and forb production, resulting in a poorly conditioned range site. Composition within this site is 3 percent grasses, 2 percent forbs, 4 percent shrubs, while the rest is classified as tree composition. The site in fair condition is composed of 15 percent grasses, 5 percent forbs, and 18 percent shrubs. The poor site produced 1315 pounds per acre taking into account the large percentage of juniper. Cover for grasses, forbs, shrubs, and trees on this area is 11 percent, 5 percent, 6 percent and 14 percent, respectively. The subdivision produced 518 pounds per acre with 23 percent grass cover and 10 percent tree cover.

The potential for the stony foothill site is 400 to 800 pounds per acre. Grasses should be the dominant vegetation under climax conditions, making up 60 percent of the composition. Shrubs would include such species as Ephedra viridis (mormon tea), Purshia tridentata (bitterbrush), and certain sagebrushes to total 30 percent of the composition. There are 1025.14 acres of the stony foothills site on the tract, or 10%.

Juniper Woodland

The soils of this site are sandy, and there is evidence of slight erosion. The composition of the juniper woodland type consists of 40% grasses, 10% forbs, 12% shrubs and is 38% juniper. The major grasses on the site are Indian ricegrass and needle and thread. The principal forbs are *Eriogonum* sp. (buckwheat), *Cryptantha* sp. (catseye), *Happlopappus* sp. (goldenweed) and *Opuntia polyacantha* (prickly pear cactus). The dominant shrub is big sagebrush. The juniper present in this type is *Juniperus osteosperma*. The estimated annual production is 800 pounds per acre (air dry). The juniper woodland site consists of 163.56 acres, or 2% of the tract.

The remaining 1003.18 acres is agricultural land that is either planted to wheat, hay pasture, or has been abandoned. See vegetation map Figure 6-1 for locations. The agricultural land is 11% of the tract.

6.1.1 Threatened, Endangered and/or Sensitive Plants

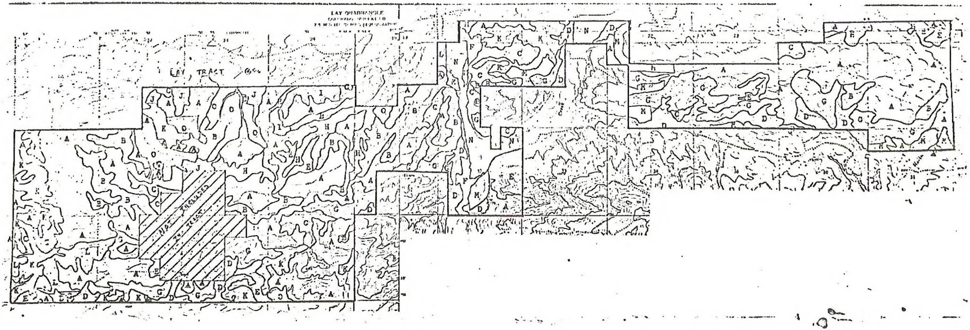
A field survey of the tract was conducted by the Bureau of Land Management in September of 1982. No known threatened, endangered, or sensitive plant species were found on the tract at that time.

6.2 Environmental Consequences

6.2.1 Vegetation

The temporary loss of the native vegetation due to mining and associated

VEGETATION Figure 6-1



LEGEND:

A. Rolling Loam
B. Clayey Slopes
C. Clayey Foothills
D. Foothill Swale
E. Sandy Foothills
F. Swale Meadow
G. Stony Foothills
H. Deep Loam
I. Alkaline Slopes
J. Claypan
K. Loamy Breaks
L. Pinyon/Juniper
M. Agricultural Land (Wheat)
N. Agricultural Land (Pasture/Hay)
O. Agricultural Land (Abandoned)

activities is approximately 2060 acres by the end of the life of the mine. This is not a significant loss, even though species diversity would be altered. The area will require some special reclamation procedures (Section 4.2) but it is felt reclamation should be successful and not significantly impact productivity.

6.2.2 Short Term vs. Long Term

Mining would result in a short term impact of the temporary loss of 2060 acres of the native vegetation; however, there are no significant losses to long term productivity due to postmining reclamation regulations.

6.2.3 Threatened, Endangered and Sensitive Plants

As there were no threatened, endangered or sensitive plant species found on the tract, there would be no significant impact to these species.

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: ______________________

Resource Element	Committed Mitigation	Anticipated Impact: Baseline	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
			116	311	636	2066			
Vegetation		Acres							
A. Rolling loam		3987.56	47	126	256	826	Fair		No significant impact due to post mining reclamation regulations although species diversity would be somewhat altered.
B. Clayey slopes		917.19	11	28	57	186			
C. Clayey foothills		527.64	6	16	32	103			
D. Foothill swale		543.82	6	16	32	103			
E. Sandy foothills		391.98	4	12	25	83			
F. Swale meadow		94.51	1	3	6	21			
G. Stony foothills		1025.14	12	31	64	207			
H. Deep loam		322.9	4	9	19	62			
I. Alkaline slopes		99.13	1	3	6	21			
J. Claypan		116.28	1	3	6	21			
K. Loamy breaks		766.03	9	25	51	164			
L. Juniper woodland		163.56	2	6	13	41			
M. Ag. Land-wheat		370.12	4	12	25	83			
N. Ag Land-Hay/ pasture		263.66	4	9	19	62			
O. Ag. Land-abandoned		369.4	4	12	25	83			

7. Wildlife

7.1 Affected Environment

7.1.1 Wildlife Habitat

Terrestrial habitats occurring on this 9,959 acre tract are those typically found in the surrounding off-tract area. The tract consists of 2% pinyon-juniper (164 acres), 66% sagebrush (6597 acres), 26% grassland (2564 acres), and 6% cropland (634 acres). The Green River/Hams Fork Final EIS (USDI-BLM, 1980) presents a thorough description of the plant species composition of these four types. The relationship between these types used for wildlife analysis and the range sites used in the vegetation section of this report are presented in Table 7-1.

One type, riparian, not used in the vegetation section will be discussed here. Even though it comprises less than 1% of the total tract acreage, it is important to wildlife. Since these areas are small, they are included in the Swale Meadow and Agricultural Land (Hay/Pasture) range sites, thus obscuring them in the vegetation discussion. The riparian type is a water associated habitat of greatly varying plant composition and diversity. It occurs along Lay Creek as scattered cottonwood groves, marshes with emergent vegetation, and grasslike areas of sedges and rushes.

These five terrestrial habitat types provide essential components needed to support wildlife. Most important is their ability to sustain big game on

TABLE 7-1

RELATIONSHIP OF HABITAT TYPES TO VEGETATION SECTION RANGE SITES

Terrestrial Habitat Type	Range Site Name	Range Site Code Letter
Pinyon/Juniper	Pinyon/Juniper Woodland	N
Sagebrush	Rolling Loam	B
	Foothill Swale	E
	Sandy Foothills	F
	Alkaline Slopes	K
	Clay Pan	L
	Loamy Breaks	M
	Agricultural Land (Abandoned Wheat)	O
	Deep Loam	J
Grassland	Clayey Slopes	C
	Clayey Foothills	D
	Swale Meadow	G
	Stony Foothills	I
Cropland	Agricultural Land (Wheat)	A
	Agricultural Land (Hay/Pasture)	H
Riparian	Included in Swale Meadow and Agricultural Land (Hay/Pasture)	G&H

critical winter range, provide sage grouse with nesting/brooding areas, and support nesting golden eagles and ferruginous hawks. These areas will be discussed further under the Animal Population Section 7.1.2.

Aquatic habitat occurs along Lay Creek. These scattered ponds and wetlands are used by ducks for feeding, resting and nesting, and also serve as water sources for terrestrial animals.

7.1.2 Animal Populations

Table 7-2 summarizes the occurrence and density of key wildlife species and Figure 7-1 and 7-2 show key wildlife use areas.

Mule deer use the entire tract year round. Their numbers increase in winter when they concentrate on the tract's critical winter range. Winter deer numbers can be estimated from the general winter densities presented in Table 7-2. This would give a minimum number of 198 deer present. Since actual counts on tract are not available, true winter numbers may be different. However, this density of 12.7 deer per square mile is low compared to other northwest Colorado game management units. Adjacent range could probably support more animals.

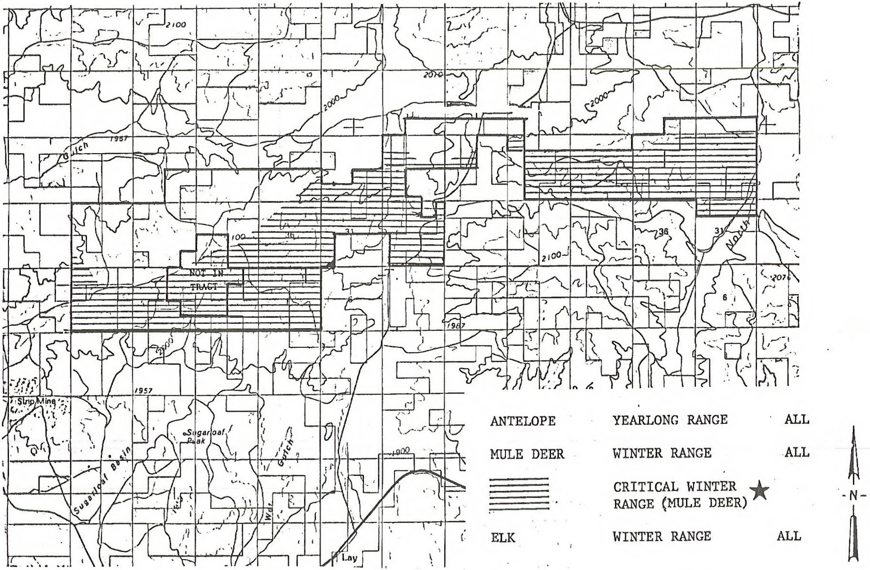
Year round antelope use occurs throughout the tract. Numbers do not increase dramatically in winter and no major concentration has been observed. As with deer, numbers of antelope can be estimated at 19 animals year round. This number may not be exact, but it does give a reasonable representation of relative numbers. Adjacent off-tract areas support similar densities, and could probably support some additional animals.

Figure 7-1

Wildlife Key Use Areas on the Lay Creek Tract

T 8 N
T 7 N

92



R 94 W R 93 W R 93 W R 92 W

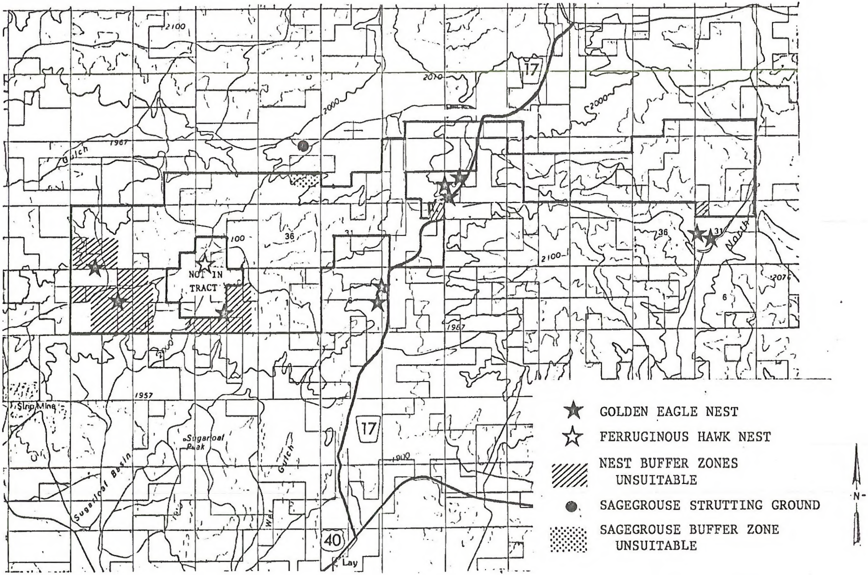
SOURCE: COLORADO DIVISION OF WILDLIFE (29 September 1982, LETTER)

★ WILL BE REVISED BY CDOW

SCALE: 1:100,000

FIGURE 7-2 WILDLIFE KEY USE AREAS ON THE LAY CREEK COAL TRACT

T 8 N
T 7 N



R 94 W R 93 W

R 93 W R 92 W

SCALE: 1:100,000

TABLE 7-2

WILDLIFE OCCURRENCE AND DENSITY

Species Present	Number Present 1/ Overall	Winter	Time of Use
Mule Deer	7.3/mi^2	12.7/mi^2	Year Round
Antelope	1.2/mi^2	1.2/mi^2	Year Round
Elk	2.5/mi^2	3.8/mi^2	Winter
Sage Grouse	4.3/mi^2	4.3/mi^2	Year Round
Ducks	.15/mi^2	N/A	Summer
Golden Eagle	14 nests	N/A	Year Round
Ferruginous Hawk	2 nests	N/A	

1/ Densities of deer, antelope, elk and sage grouse are being revised by Colorado Division of Wildlife. If significant increases occur, the new, higher numbers will be used in the decision-making process regarding leasing and mitigation.

Elk occur in winter on the entire tract. Until recently elk use was sporadic and did not occur every year. For the past several years elk have used the tract more regularly. Therefore, the importance of this area appears to be increasing due to vegetation condition or a change in elk behavior. Colorado Division of Wildlife now considers the tract to be 100% elk winter range (September 29, 1982 letter). A winter elk density of 3.8 per square mile has been estimated using Colorado Division of Wildlife's 1981 post hunt population estimate of 7,332 elk in DAU E-2. Using this density, a total tract estimate of winter population would be 59 elk.

A sage grouse strutting ground occurs less than 1/2 mile north of the tract boundary in NE 1/4, Section 25, T. 8 N., R. 94 W. As many as 100 grouse have

been counted on this ground during breeding season in April and May. On-tract conditions are favorable for grouse nesting and rearing of young. It is probable that this occurs on-tract throughout the sagebrush habitat type, and wetter grassland areas along drainages. Although no tract specific nesting/brood rearing data is available, it is expected that these areas are important to the local sage grouse population. Additional data and analysis is needed to determine the specific location and importance of these nesting/brood rearing areas.

Ducks feed, rest and nest in the ponds and marshes in the Lay Creek drainage. As many as 20 teal, mallards, and pintails have been observed in the pond in the SE 1/4, Section 21, T. 8 N., R. 93 W. This indicates high use on these small ponds which average less than one surface acre per pond.

Ten golden eagle nests could be affected by mining this tract (Figure 7-2). Of the ten, five would be adequately protected by stipulations (see 7.1.5). The five remaining nests are not fully protected by committed stipulation and buffer zones. They occur very near County Road 17. BLM cannot control use of County Road 17. Proposed mitigation (Section 7.1.6) could reduce impacts to these nesting eagles.

One ferruginous hawk nest occurs. It is protected by a buffer zone that has been deleted from the tract. The location of this hawk nest is shown in Figure 7-2.

7.1.3 Threatened and Endangered Animals

No T/E animals or critical habitats are known to occur.

7.1.4 Wild Horses

None are present.

7.1.5 Land Use Planning Stipulations

The Williams Fork Management Framework Plan Coal Amendment 1979 provides for mitigation of losses of certain key wildlife species habitats when they result from surface mining and subsurface mining facilities. The following stipulation would apply to the disturbed area of this tract:

"The lessee shall be required to mitigate for mule deer, elk, antelope and sage grouse habitat loss and the resultant loss or displacement of this species, as a key indicator species, due to coal mining operations. The lessee shall be required to submit for approval to the Authorized Officer a habitat recovery and replacement plan for protection or enhancement of the deer, elk, antelope and sage grouse populations affected by habitat loss or displacement from historic habitat.

The habitat recovery and replacement plan shall be developed in consultation with the Authorized Officer and the Colorado Division of Wildlife (CDOW) based on estimates of lost and disturbed habitat as described in this document. If

the mine plan submitted by the lessee indicates figures different from the lost habitat estimates used in this document as to quality and quantity of habitat lost or disturbed, mitigation alternatives shall be recalculated based upon revised data contained in the mine plan.

The final habitat recovery and replacement plan shall indicate the methods to be employed by the lessee which will ensure that the carrying capacity of the recovered or replaced land has the capacity to support this indicator species as agreed upon by the Authorized Officer and CDOW.

Mitigation methods may require the lessee to employ techniques for wildlife range manipulation or intensive wildlife range management. Habitat recovery may not be completely feasible in the permit area; therefore, recovery or replacement may be accomplished on lands made available through the surface management agency, the state, or the lessee outside the permit area in combination with recovery and replacement methods on suitable land within the permit area.

The habitat recovery and replacement plan shall include the following.

1. A habitat analysis of the permit area which:

    a. identifies the above species which occupy the permit area, and
    b. includes an analysis of the quality or carrying capacity of the habitat for this species.

2. A detailed description of the methods selected by the lessee to mitigate habitat loss, together with a comparative analysis of alternate methods which were considered and rejected by the lessee and the rationale for the decision to select the proposed methods.

The methods utilized by the lessee for recovery and replacement may include, but are not limited to, the following techniques:

a. Increasing the quantity and quality of forage available to wildlife

b. The acquisition of critical wildlife habitats

c. Mechanical manipulation of low quality wildlife habitat to increase its carrying capacity for selected wildlife species

d. Recovery, replacement or protection of important wildlife habitat by selected fencing

3. A timetable giving the periods of time which would be required to accomplish the habitat recovery or replacement plan and showing how this timetable relates to the overall mining plan.

4. An evaluation of the final plan by CDOW. The state shall comment on the methods selected and the techniques to be employed by the lessee and may recommend alternate recovery or replacement methods. If the state has recommended an alternate method, the lessee shall consider the state's recommendation and, if the lessee rejects the state's plan, the lessee shall indicate its reasons as required by provision 2 above. If no state comment is included in the plan, the lessee shall verify its consultation with the state,

and the plan may be considered without state comment."

Mitigating measures to protect five golden eagle nests (adjacent to County Road 17) and one ferruginous hawk nests (within the tract boundary) have been committed (Figure 7-2). The buffer zones lands have been deleted from the tract and are unsuitable for surface mining and facilities (Williams Fork MFP Coal Amendment Update, 1982), although this mitigation does not fully protect these eagle nests from impacts of increased orad traffic along County Road 17.

The following stipulations would be needed to protect the sage grouse strutting ground in Section 25.

1. No surface occupancy such as buildings, roads, etc., at any time.
2. No activity such as driving, walking, etc. between March 1 and May 31, annually.

These stipulations apply to the following described lands (Figure 7-2):

T. 8 N., R. 94 W., SEc. 25: N 1/2 SE 1/4

The following stiulatins would be needed to adequately protect five golden eagle nests that occur on and near the tract.

1. No surface occupancy at any time.
2. No activity between February 1 and July 31, annually.

These stipulations apply to the following described lands within the tract (Figure 7-2):

T. 7 N., R. 94 W.

Sec. 2: S 1/2 SW 1/4, W 1/2 SE 1/4, SW 1/4 NE 1/4, W 1/2 SE 1/4 NE 1/4, W 1/2 E 1/2 SE 1/4

Sec. 3: Lot 8, E 1/2 SE 1/4 SE 1/4, SW 1/4 NW 1/4, W 1/2 SW 1/4, W 1/2 SE 1/4 NW 1/4, W 1/2 E 1/2 SW 1/4

Sec. 4: Lot 5, S 1/2 N 1/2, E 1/2 E 1/2 SW 1/4, SE 1/4

T. 8 N., R. 92 W., Section 31: Lot 5.

T. 8 N., R. 93 W., Section 32: Lot 1.

T. 8 N., R. 94 W., Section 33: SW 1/4, W 1/2 SE 1/4, W 1/2 E 1/2 SE 1/4.

7.1.6 Proposed Mitigation

Five golden eagle nest sites along County Road 17 that are not adequately protected by stipulation on tract and buffer zones off tract would require additional mitigation to reduce adverse impacts (Figure 7-2). Vehicle traffic, both coal trucks and employees' vehicles, should be rerouted to avoid this road in breeding season, February 1 to July 31. Busing or carpooling might be used to transport employees, thus reducing the number of vehicles passing these nests. Other measures may be required or substituted upon approval of U.S. Fish and Wildlife Service. They have responsibility for

protection of eagle nests and would have to be consulted, if this tract were leased.

Busing, carpooling, or other measures may be needed to reduce roadkill on Highway 40 and county roads 7 and 17.

7.2 Environmental Consequences

7.2.1 Wildlife Habitat

Mining and associated facilities would disturb 2066 acres of on-tract terrestrial habitats by end of mine life. The majority of this loss would occur in the sagebrush and grassland habitat types. These habitats serve as important winter ranges for mule deer, elk and antelope, and nesting/brood rearing areas for sage grouse.

Loss of this 2066 acres would displace the mule deer, elk, antelope and sage grouse that are presently dependent upon this vegetation for food and cover. Without mitigation these animals would probably be lost. Committed mitigation discussed in Section 7.1.5 would reduce the unavoidable adverse impacts of habitat destruction by improving adjacent undisturbed habitats. By increasing carrying capacities on adjacent land, nearly 100% of the displaced deer, elk, antelope and sage grouse could be supported, thus eliminating significant losses.

Aquatic and riparian habitats in Lay Creek drainage would not be disturbed and therefore, not impacted.

Impacts resulting off-site disturbance can not be evaluated until specific locations are known. If these impacts affect mule deer, elk, antelope or sage grouse habitats, they would be mitigated by committed measures discussed in Section 7.1.5.

7.2.2 Animal Populations

An estimated 41 mule deer, 12 elk, 4 antelope and 14 sage grouse would be displaced by habitat destruction by end of mine life. Adjacent habitats to support these populations at present levels are available, if committed mitigation is implemented. With this mitigation population losses would be reduced to an acceptable level by improving elk, deer and antelope winter ranges and sage grouse nesting/brood rearing habitat adjacent to disturbed areas.

Duck populations would not be impacted significantly.

Surface occupancy and mining associated activity in the breeding season would not be allowed within the buffer zones discussed in Section 7.1.5 for the protection of nesting golden eagles. This mitigation would minimize adverse impacts to five golden eagle nests.

Impacts to five of the ten golden eagle nest sites would occur even with the above stipulations. These sites are located just west of County Road 17 in Sections 6, 28 and 29 (Figure 7-2). Increased vehicle traffic and human activity would cause abandonment of these nest sites. Local population

declines would result, since other available nest sites are occupied. Mitigating measures could reduce the severity of adverse impacts.

Increased vehicle traffic would increase the number of animals killed on Highway 40 and county roads 7 and 17. Losses of deer, elk, antelope and sage grouse could be high enough to require mitigating measures. Busing, carpooling, or other measures to be determined in consultation with Colorado Division of Wildlife could reduce losses. Further study is needed to determine the significance of these expected losses, as no data exists for the county roads.

7.2.3 Threatened and Endangered Animals

No adverse impacts would result, as no T/E species occur.

7.2.4 Wild Horses

None occur, so none would be impacted.

7.3 Short Term vs. Long Term Productivity

After mining is completed the disturbed wildlife habitats would be in varying stages of reclamation. Some areas would be fully reclaimed to premining vegetation type. Others would still be barren. Their usefulness to wildlife would vary accordingly.

On fully reclaimed sites use by deer, elk, antelope, sage grouse, ducks and raptors should return to premining levels. Reduced carrying capacity would continue for 5-15 years in the unreclaimed sagebrush and grassland types. As long as 50 years may be required to reestablish cottonwood trees and junipers.

The capacity of disturbed sites would be diminished until successful reclamation is complete. Eventually all lands should be returned to premining capacities with no long term (beyond reclamation) impairment of productivity.

7.4 Consultation and Coordination With Other Agencies

Informal consultation with U.S. Fish and Wildlife Service regarding protection of golden eagles and ferruginous hawks was conducted by phone conversations and metings with Ronel Finley and Mike Lockhart.

Informal consultation with Colorado Division of Wildlife regarding consideration of state species of concern was conducted by phone conversations with Bill Clark and John Gray.

Formal consultation on all tract has been initiated with these agencies. It will be completed upon receipt of their response letters.

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: New Mine

105

Resource Element	Committed Mitigation	Baseline	Anticipated Impact 1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Habitats (acres)									
Pinyon/Juniper	Reclamation Regs	164	2	6	13	41	Good	None	*Not significant with committed mitigation.
Sagebrush	"	6597	73	196	401	1302	"	"*	
Grassland	"	2564	34	90	184	599	"	"*	
Cropland	"	634	7	19	38	124	"	"*	
Riparian	"		0	→	→	→	Acceptable	"	
Aquatic	"		0	→	→	→	"	"	
Populations									
Elk	Stipulation	59	1	2	4	12	Acceptable	"*	*Not significant with committed mitigation.
Mule deer	"	198	3	6	13	41	"	"*	
Antelope	"	19	0	1	1	4	"	"*	
Sage grouse	"	67	1	2	4	14	"	"*	
Ducks	N/A		0	→	→	→	"	"	
Golden eagle	Buffer Zone 1/	10 nests	5	→	→	→	"	"**	**Significant impact -could be reduced by proposed mitigation.
Ferruginous hawk	"	2 nests	0	→	→	→	"	"	
T/E	N/A	None					"	"	
Wild horses	"	"							
Fish	"	"					"	"	

1/ Buffer zones protect only 3 on tract nests. Five off-tract nests would be significantly impacted.

8. Recreation

8.1 Affected Environment

A limited number of hunters utilize the tract pursuing small game, antelope and deer by permission of private landowners. Some wildlife observation and sightseeing may occur within the proposed tract from Moffat County Road 17. Approximately 258 acres of public land on the tract has public access from County Road 17. The majority of the dispersed outdoor recreation on public lands takes place to the north, south and west of the tract.

There are no private or public recreation developments on or adjacent to the tract. No current recreation data is available.

8.2 Environmental Consequences

Recreation use is expected to increase in proportion to population growth with or without the proposed mine. The nature of recreation would remain dispersed with the exception of urban areas. If urban facilities do not keep abreast with population growth, adverse conditions may arise such as lowering the quality of facilities and recreation opportunities.

Displacement of wildlife, hunters and sightseers would be of minimal impact. Acreage with the same type of capacity and characteristics exist in large quantity within Moffat County. The projected population growth rate related to the tract would have no significant impact on dispersed recreation in

northwest Colorado. Insignificant impacts are also expected on urban recreation facilities and opportunities.

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: 1

Resource Element	Committed Mitigation	Anticipated Impact: Baseline	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Recreation									
ACEC	FLPMA	Incomplete planning					No recreation data		No ACEC identified
Wilderness	FLPMA & Wilderness Act	None	→	→	→	→	Good		No significant impact
Wild and scenic rivers	NPS/Wild and Scenic Rivers Act	None	→	→	→	→	Good		"
Land use planning stips.		None	→	→	→	→	No current recreation data		"
Proposed mitigation		None	→	→	→	→	"		"
Values		Hunting, wildlife viewing, sightseeing	Loss of all opportunities on tract	→	→	Hunting, wildlife viewing, sightseeing	"		"

9. Visual Resources

9.1 Affected Environment

The entire tract is in VRM Class IV due to low visual sensitivity. Scenic quality is rated B and C and falls into the seldom seen and foreground/middleground distance zones. The foreground/middleground zones are highly visible from Moffat County Road 7.

Topography includes the Lay Creek drainage, rolling sage covered hills with steep sandstone outcrops and stands of juniper trees providing contrast in an otherwise monotonous landscape. The area confined within the Lay Creek bottom area is utilized for agriculture.

9.2 Environmental Consequences

Surface mining, mine facilities, roads, powerlines and a rail spur would be a contrast from the undeveloped landscape. The nature of a surface mine does not meet the modification level of a VRM Class IV rating. The disturbed areas will be lowered to VRM Class V until reclamation is completed. Areas highly visible from Moffat County Road 7, foreground/ middleground distance zone, would be most affected. However all impacts on tract would be insignificant due to Colorado mined land reclamation regulations. There would be additional impacts to the landscape from offsite construction of powerlines and the railroad spur. Severity of these impacts will depend on routes and design.

9.2.1 Short Term vs. Long Term

Impacts to visual resources would last throughout mine life. Long term impacts would be insignificant.

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: 1

Resource Element	Committed Mitigation	Anticipated Impact: Baseline	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Visual Resources									
Class	Colorado mined land reclamation regulations	IV	V 116 acres	V 311 acres	V 636 acres	Interim Class V back to Class IV	Good		Areas with surface disturbance would be lowered to Class V until reclamation is completed. Short term impacts would occur in foreground/middleground distance zones. No significant impacts.
Land use planning stips.	"	None					"		
Proposed mitigation	"	None					"		

10. Cultural Resources

10.1 Affected Environment

A reconnaissance level cultural resource survey has been conducted within the Lay tract; LSRA Coal Lease Sites Reconnaissance Inventory for Site Specific Analysis - Coal Lease #2, BLM 1979. This survey was conducted under very short time frames and with a minimum recording of the cultural materials found. Consequently the data obtained in this manner can only be used in gross estimations of potential cultural resources patterns, and locations.

Thirteen prehistoric locations, ranging from isolated finds to sites, were located. The present defined pit locations contained only three sites and some prehistoric lithic scatters. However, due to the nature of this survey, determination of eligibility to the National Register of Historic Places and consultation with the Colorado State Historic Preservation Officer SHPO (36 CFR 800) cannot be carried out until these loctions are rerecorded. Other cultural resources located during subsequent Class III surveys will have SHPO consultation and eligibility determinations completed after the Class III surveys are completed.

10.2 Environmental Consequences

A full assessment of impacts to the cultural resources cannot be made until a Class III (100% cultural inventory) has been completed for the development and mine areas.

Determination of a cultural resources significance is a process of consultation with the Colorado State Historic Preservation Officer (SHPO) (36 CFR 800) and the Bureau of Land Management. However, this consultation cannot be completed until a Class III cultural resource survey has been carried out and sites identified for any areas on tract that will be disturbed. This will be done after the tract is leased.

Impacts that could occur to cultural resources, discussed below, are felt to be unavoidable. However, committed mitigation, as outlined in Section 10.2.1 will mitigate the following impacts to cultural resources to an insignificant level in that the committed mitigations will recover the maximum data potential from identified cultural reources.

1) Mining and construction activities could displace and damage archaeological resources that remained undetected despite the Class III surveys in the areas. These would affect both surface and subsurface cultural resources.

2) Archaeological resources that cannot be avoided are subjected to mitigation measures involving recording, mapping, collecting and possibly excavation. However, due to the state of the art in archaeological methods and theory, information and data not recoverd during mitigation efforts will be lost. It should be noted that "mitigation efforts" do not recover 100 percent of a site's data. Mitigation is an effort to retrieve a sufficient amount of information, based upon a suitable research design, to understand the cultural resource.

3) Surface disturbance affecting land areas surrounding existing archaeological sites could impact cultural resources by (a) altering the existing environment which might otherwise serve as a model for past conditions and (b) introducing new elements into the area which would disrupt the integrity of the site and (c) changes in the adjacent environment would limit the boundaries of data collection as needed for the interpretation of the site.

4) Increased human activities in a previously low visitation, limited access, area due to mining activities can result in increased vandalism or unintentional damage by recreators, unaware of the value of archaeological, would destory irreplaceable data. While the extent of vandalism cannot be quantified, it is a significant impact in its destruction of the resource, resulting in loss of information that might have otherwise been recoverable and applied through scientific research.

10.2.1 Mitigation: Committed

(1) The lessee shall conduct a Class III (100%) cultural resource intensive field inventory on the portion of the lease area that was not previously inventoried at such a level of intensity before undertaking any activities that may disturb the surface of that portion of the tract lands. The lessee shall contact the BLM District Manager prior to survey for prior survey locations. The inventory shall be conducted by a qualified professional cultural resource specialist (i.e., archaeologist, historian or historical architect, as appropriate), approved by the authorized officer, and a report

of the inventory and recommendations for protecting any cultural resources identified shall be submitted to the Administrator of the Technical Center (or the District Mining Supervisor if activities are associated with coal exploration outside an approved mining permit area) and the authorized officer of the BLM. The lessee shall undertake measures, in accordance with instructions from the Administration of the Technical Center (or the District Mining Supervisor if activities are associated with coal exploration outside an approved mining permit area), to protect cultural resources on the leased land. The lessee shall not commence the surface disturbing activities until permission to proceed is given by the Administrator of the Technical Center (or the District Mining Supervisor if activities are associated with coal exploration outside an approved mining permit area).

(2) The lessee shall protect all cultural resource properties within the lease area from lease-related activities until the cultural resource mitigation measures can be implemented as part of an approved mining and reclamation plan or exploration plan.

(4) The cost of conducting inventories, preparing reports, and carrying out mitigation measures shall be borne by the lessee.

(5) If cultural resources are discovered during operations under this lease, the lessee shall immediately bring them to the attention of the Regional Director (or the District Mining Supervisor if activities are associated with coal exploration outside an approved mining permit area), or the authorized officer of the surface managing agency if the Administrator of the Technical

Center, or District Mining Supervisor, as appropriate, is not available. The lessee shall not disturb such resources except as may be subsequently authorized by the Administrator of the Technical Center (or the District Mining Supervisor if activities are associated with coal exploration outside an approved mining permit area). Within two (2) working days of notification, the Administrator of the Technical Center (or the District Mining Supervisor if activities are associated with coal exploration outside an approved mining permit area) will evaluate or have evaluated any cultural resources discovered and will determine if any action may be required to protect or preserve such discoveries. The cost of data recovery for cultural resources discovered during lease operations shall be borne by the surface managing agency unless otherwise specified by the authorized officer of the BLM or of the surface managing agency (if different).

References Cited

Bureau of Land Management, 1979. LSRA Coal Lease Sites Reconnaissance Inventory for Site Specific Analysis - Coal Lease #2, by S. Hansen. Bureau of Land Management Little Snake Resource Area.

Bureau of Land Management. A Survey of Vandalism to Archaeological Resources, by P. R. NIckens, S. L. Larralde, and G. C. Tucker Jr. Bureau of Land Management, Colorado Series Nr. 11.

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: 1

Resource Element	Committed Mitigation	Anticipated Impact: Baseline	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Cultural Resources	-Antiquities Act of 1906 -Historic Sites Act of 1935 -Historic Preservation Act of 1966 as amended -National Environmental Policy Act of 1969 -Archaeological and Historic Data Conservation Act of 1974 -Executive order 11593 -Procedures for the Protection of Historic and Cultural Resources (36 CFR 800) -Colorado Antiquities Act of 1973 -Colorado Land Use Act of 1974 Archaeological Resources Protection Act of 1979	Inadequate	Unknown	———>	———>	Unknown for 30 years	Poor-survey conducted was only a reconnaissance that only gave an idea of what may be present on the tract. Cultural resources located need to be recorded and evaluated "LSRA Coal Lease Sites Reconnaissance Inventory for Site Specific Analysis-Coal Lease #2 -BLM 1979	Loss of cultural resource data through vandalism, unintentional dmage, undetected sites being destroyed and mitigation efforts	Insignificant impact. See narrative.

11. Economics

11.1 Affected Environment

The impacted area consists of the eastern portion of Moffat County and the western portion of Routt County and includes the communities of Craig, Maybell, and Hayden.

Eastern Moffat County is expected to have a relatively stable population in the 1990s as the result of slow growth rates in coal production and electric power demand. Therefore, the labor market is expected to be slack, with some surplus labor available for new jobs. Western Routt County is expected to experience a declining trend as some of the older coal deposits become depleted, resulting also in some slack in the labor market and available surplus labor.

Consequently, the capital improvement requirements of all the communities should be small.

11.2 Environmental Consequences

Leasing the Lay Tract would cause impacts to three ranch operations and moderately significant impacts to Moffat County's revenues. No significant impacts would be caused to the communities in the way of population or employment growth.

At peak construction in 1992, Maybell's population would be increased about one percent, while the populations of Craig and Hayden would rise less than one-half percent. Full mine operation, in 1995 and after, would increase the populations of all three communities less than one-half percent. Because of the slack labor market expected in the area, little or no inmigration would be required.

Craig would receive employment gains of about 90 at peak construction and 140 during full mine operation, while total employment in Hayden would increase by about 10 during peak construction and 20 at full mine operation. Employment growth in Maybell would be less than five during both periods. Because most of these jobs would be filled by local residents, population increases at peak construction would be only about 70 in Craig, 10 in Hayden, and five in Maybell. Very little population growth would occur in any of the communities during full mine operation. Housing problems should be minor. Construction of the mine would create annual wage and salary income of about $3,200,000 in Craig and $600,000 in the other communities, including secondary employment. At full operation the mine would raise income about $4,200,000 in Craig and $600,000 in the other communities.

Impacts to livestock grazing would not be significant to the area and individual ranchers. Loss of critical lambing areas would occur, resulting in an average gross revenue decrease of 15 percent. Each operation would incur a similar proportionate loss. The three ranching operations have been tentatively identified as qualified surface owners from the information available. A qualified surface owner has a choice of whether to be

compensated for impacts to his operation or not to permit mining. For the area, the total effect would be a reduction of one percent in agricultural sales. Losses to area business from reduced deer and elk hunting would be insignificant.

The mine would pay a total of $6,200,000 in ad valorem and severance taxes and federal royalty. Of that amount, some $1,050,000 would accrue or be returned to Moffat County. Craig would receive an additional $80,000 annually in property and sales taxes induced by growth plus its severance tax share, but revenue benefits to Maybell and Hayden would be small.

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: New Mine

Resource Element	Committed Mitigation	Anticipated Impact					Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
		Baseline	1992	1995	2000	EML			
			(Percent of Baseline)						
Population	None	Varies by year				NA	Medium	Only construction materials	Reasonable baseline projections cannot be made beyond the year 2000
Craig			0	0	0				
Maybell			1	0	0				
Hayden			0	0	0				
Employment	"	"				"	"	"	
Moffat County			1	1	1				
Routt County			0	0	0				
Wage & salary income	"	"				"	"	None	
Moffat County			2	2	2				
Routt County			0	0	0				
Operating revenue	"	"				"	"	"	
Moffat County			0	10	9				

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: New Mine

Resource Element	Committed Mitigation	Anticipated Impact					Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
		Baseline	1992	1995	2000	EML			
Community revenue	None	Varies by year				NA	Medium	None	
Craig			0	2	2				
Maybell			0	0	0				
Hayden			1	0	0				
Agricultural sales	"	"				"	"	"	
Area			1	1	1				
Impacted ranchers			15	15	15				

12. Social

12.1 Affected Environment and Environmental Consequences

Craig, Hayden, and Maybell would potentially be affected socially by lease of this tract. Impacts would be insignificant for any of these three communities.

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: #1 Surface

Resource Element	Committed Mitigation	Anticipated Impact	1990	1991	1982	1993	1994	1995+	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Social	—	Craig:							Poor		
		Baseline:	18611	19338	18045	18124	18289	18453			
		Total Pop. Imp.:	11	89	95	22	0	0			
		Hayden:									
		Baseline:	2889	2879	2811	2760	2734	2705			
		Total Pop. Imp.:	3	9	9	2	0	0			
		Maybell:									
		Baseline:	417	429	401	402	406	410			
		Total Pop. Imp.:	3	6	6	3	0	0			

13. Land Use

13.1 Affected Environment

13.1.1 Agricultural

Livestock grazing on the tract is divided between five grazing operations. The following table displays the information on these grazing operations.

Grazing Operator	Season of Use	Livestock Class	AUMs Private	AUMs State	AUMs Federal	AUMs Total AUMS on Tract	AUMs Estimated AUMs off Tract
Two Bar Ranch Co. c/o Raftopoulis Brothers	Spring/ Fall	Sheep, Cattle	205	0	67	272	11,000
S. McIntyre	"	Cattle	80	0	20	100	2,500
G. Culverwell	Spring/ Summer	Sheep, Cattle	295	80	30	405	16,000
J. Peroulis	Spring/ Summer	Sheep	67	0	15	82	9,600
Sombrero Ranches	Spring/ Fall	Horses	96	0	133	229	7,200

13.1.2 Dwellings

There is one residence within the boundary of the tract.

13.1.3 Rights-of-Way

No major rights-of-way exist on tract. Minor rights-of-way can be moved or mitigated. The minor rights-of-way on tract are County Road 17, a natural gas pipeline (C-15096-2 7/8 OD) and a few fences and jeep trails.

13.1.4 Withdrawals

Information on lands under withdrawal status is not available at this time.

13.2 Environmental Consequences

13.2.1 Agriculture

There would be a temporary loss of approximately 1088 total AUMs from the tract. Two Bar Ranch Company would lose approximtley 272 AUMs, which is about 2% of the entire ranching operation. S. McIntyre would lose approximately 100 AUMs due to mining, which is about 4% of his entire ranching operation. G. Culverwell would lose approximately 405 AUMs, which is about 2.5% of his entire ranching operation. J. Peroulis would lose approximately 82 AUMs, which is less than 1% of his entire ranching operation. The Sombrero Ranches would lose approximatley 229 AUMs, or about 3% of the entire ranching oeration. The loss of less than 1% to 4% of an entire grazing operation is not a significant loss. Therefore none of the operators would be significantly impacted due to mining in terms of AUMs lost.

Three of these allotments, however, are critical lambing areas and are

therefore important to the ranch operator. The Two Bar Ranch Company would lose a critical lambing area. The use is primarily in the spring, a time of year when other areas are still covered with snow. G. Culverwell and J. Peroulis would also lose critical lambing areas. All three operators have been tentatively identified as qualified surface owners from the information available. A qualified surface owner has a choice of whether to be compensated for impacts to his operation or not to permit mining.

13.2.2 Dwellings

The location of the residence is unsuitable for mining as it has been identified as a floodplain and therefore will not be impacted.

13.2.3 Rights-of-Way

The county road would not be impacted as the extraction areas do not affect the road. The fences and jeep trails could be relocated by the lessee and is considered an insignificant impact due to the low cost to relocate and the nature of the ROW. The natural gas pipeline is a 2 7/8 OD line running through Sections 24, 25, and 36 in T. 8 N., R. 93 W. This small a line could be relocated by the lessee and would be at their expense.

13.2.3 Short Term vs. Long Term

There would be a short term temporary loss of 1088 AUMs due to mining; however, the long term productivity would return due to post mining regulations.

13.2.3 Irreversible/Irretrievable

There would be no irreversible/irretrievable impacts to grazing.

THE SITE SPECIFIC ANALYSIS

Tract Name or Number: Lay Creek Tract

State: Colorado

Leasing/Development Scenario: ______________________

Resource Element	Committed Mitigation	Anticipated Impact: Baseline	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Land Use:									
Agricultural: Grazing		1088 AUMs 3 lambing areas*	———> 3	———> 3	———> 3	———> 0	Fair		The 1088 AUMs would be available for use approximately 40 years after the end of the mining operation due to post mining reclamation regulations. *See narrative.
Agricultural:									
Wheat		370.12 acres	4	12	25	83	Fair		Insignificant
Pasture (hay)		263.66 acres	4	9	19	62			
Abandoned		369.4 acres	4	12	25	83			
Dwellings		One residence on tract			0				See narrative.
Rights-of-Way		No major rights-of -way on tract	Minor rights-of-way on tract would be moved or mitigated						
Withdrawal									

14. Transportation

14.1 Affected Environment

14.1.1 Highway Transportation

The major transportation routes affected are U.S. Highway 40 south of the tract, Moffat County Road 17 running through the tract. U.S. Highway 40 is a paved, two-lane, east-west highway running between Denver, Colorado, and Salt Lake City, Utah and serves a number of smaller towns in between. The average daily traffic (ADT) on U.S. Highway 40 between Lay and Craig is 1600; between Craig and Hayden the ADT is 3400. Traffic on County Road 17 is assumed to be light. There is no traffic data for any county roads.

Table 14-1 gives the projected ADT for U.S. Highway 40 between Lay and Craig (Segment A) and between Craig and Hayden (Segment B). The table also gives the design hour volume (DHV) which is defined as the 30th highest hourly volume occurring in a year. DHV is multiplied by ADT to project peak hour traffic (PHT) given in Table 14-2. Any projections past the year 2000 are inaccurate.

TABLE 14-1

PROJECTED AVERAGE DAILY TRAFFIC FOR U.S. HIGHWAY 40

Road Segment	Segment Length	Average Daily Traffic 1985	1992	1995	2000	EML	DHV
A	17.4	1750	1950	2050	2200	2550	.14
B	14.8	3900	4600	4900	5400	7000	.12

Table 14-2 gives the volume to capacity ratios (%) for the peak hour traffic through EML. This ratio, between PHT and the highway capacity, indicates traffic conditions on the highway during high use periods. Any coefficient greater than 1.0 will indicate that significant congestion will occur resulting in time delays and increased safety risks. A coefficient of 0.8-1.0 will indicate a high probability for at least monetary or minor road congestion. A coefficient of 0.8 or below will indicate that the road segment has adequate capacity to handle the projected traffic. The level of service for Segment A is expected to remain constant through the next 20 years while the level of service for Segment B is lowered through the year 2000 when it approaches capacity.

TABLE 14-2

PROJECTED VOLUME/CAPACITY RATIO - U.S HIGHWAY 40

Road Seg.	Peak Hour Traffic 1985	1992	1995	2000	EML	Capacity (Volume @ Service Level "C")	Volume/Capacity Ratio 1985	1992	1995	2000	EML
A	245	273	287	308	357	910	.27	.30	.32	.34	.39
B	468	552	588	648	840	680	.69	.81	.86	.95	1.24

Table 14-3 indicates the total number of accidents projected for the road segments. By determining the vehicle miles travelled per year, times the accident rate divided by one million; the total number of accidents per year can be projected. The same methodology is used to project the number of fatal accidents per year, except the product is divided by 100 million instead of one million. The methodology assumes that no significant increase in the accident rates will occur.

TABLE 14-3

PROJECTED ACCIDENT RATE FOR U.S. HIGHWAY 40

Road Seg.	Seg. Lgth.	Average Daily Traffic 1985	1992	1995	2000	EML	Total Accident Rate (1980)	Total Accidents 1985	1992	1995	2000	EML
A	17.4	1750	1950	2050	2200	2550	1.61	18	20	21	22	26
B	14.8	3900	4600	4900	5400	7000	2.88	61	72	76	84	109

14.1.2 DRGW Railroad

The Denver and Rio Grande Western Railroad has a main line running from Denver through the Moffat Tunnel terminating in Craig with a 25 mile spur line to Axial south of Craig. Currently the rail line between Craig and Bond has approximately eight (8) unit trains per day passing over the tracks while the segment from Bond to Denver has twenty (20) unit trains per day. The present control system is an automatic block system. Six at-grade crossings exist along this route. Traffic delays at each crossing are currently less than 15 minutes a day. Table 14-4 lists Colorado crossing I.D. number, approximate location, and existing hazard rating through 1996.

TABLE 14-4

EXISTING RAILROAD GRADE CROSSING HAZARD RATINGS

Colorado Crossing I.D. Number	Location	Hazard Rating (Accidents per five years	Hazard Rating 1996
0040-28-05	West of Hayden	.63	.92
0040-28-10	East of Hayden	.15	.84
0040-28-15	East of Hayden	1.25	.91
0134-28-05	East of Toponas	.15	.66
0394-42-05	Craig	.63	4.85
0394-42-10	Craig	1.32	1.56

Source: Colorado Department of Highways.

14.2 Environmental Consequences

14.2.1 Highway Transportation

Scenario 1

Table 14-5 gives the increases in ADT and PHT as a result of the new mine. Table 14-6 gives the increased volume to capacity ratios using the same methodology as explained in Section 14.1. The increase in traffic would have an insignificant effect on highway segment A which has enough excess capacity to absorb the project's work vehicles without lowering the service level. The service level for segment B is expected to be lowered without the project, thus there is no significant impact.

Table 14-7 indicates that the number of increased traffic accidents resulting from the proposed mine is low.

Moffat County Road 17 would be the main access route to the mine. Traffic would increase dramatically on this road with associated impacts of increased noise affecting residents as well as increased wildlife disturbance. Employee and other mine traffic would increase ADT by approximately 150.

TABLE 14-5

INCREASED AVERAGE DAILY TRAFFIC - U.S. HIGHWAY 40

Road	Average Daily Traffic					Increase in Peak Hour Traffic				
Segment	1985	1992	1995	2000	EML	1985	1992	1995	2000	EML
A	0	2050	2200	2350	0	0	70	150	150	0
B	0	4650	4950	5450	0	0	15	15	15	0

TABLE 14-6

INCREASED VOLUME/CAPACITY RATIO - U.S. HIGHWAY 40

Road Segment	Increased Peak Hour Traffic 1985	1992	1995	2000	EML	Capacity (Volume @ Service Level "C")	Volume/Capacity Ratio 1985	1992	1995	2000	EML
A	0	243	437	458	0	910	0	.38	.48	.50	0
B	0	563	603	663	0	680	0	.83	.88	.97	0

TABLE 14-7

INCREASED ACCIDENTS FOR U.S. HIGHWAY 40

Road Segment	Segment Length	Increase In Average Daily Traffic 1985	1992	1995	2000	Total Accident Rate (1980)	Increase In Accidents 1985	1992	1995	2000
A	17.4	0	100	150	150	1.61	0	1	2	2
B	14.8	0	50	50	50	2.88	0	1	1	1

Other impacts associated with the project's transportation needs would be wildlife disturbance (see Wildlife), increased exhaust emissions, increased surface disturbance (see Vegetation) and increased noise (see Noise) as well as increased maintenance costs.

14.2.2 DRGW Railroad

The project would add approximately one unit train per day. One unit train would carry approximately 7500 tons of coal. One half unit train per day would be loaded with the coal produced each day while the other half would return to the mine. The limiting factor for the rail line's capacity is anticipated to be rolling stock and power equipment, not the rail's carrying

capacity. The addition of one trail per day will increase the grade crossing's hazard rating.

In addition, one at grade crossing would be added by the proposed 25 mile railroad spur to the mine. This crossing would be located west of Craig and would cross Highway 40.

Because of lack of data, no projection for rail capacity per volume may be made. If the number of train movements a day stays under 25, which is expected, no impacts on the system's capacity would occur.

14.2.2 Short Term vs. Long Term

Impacts to the transportation system would be short term.

14.2.3 Unavoidable Adverse Impacts

Adverse environmental impacts on the transportation system which cannot be avoided are: increased traffic accidents, increased grade crossing hazard ratings, increased capital expenditures for road maintenance and surface disturbance for new roads, improvements and the railroad spur as well as increased noise.

14.2.4 Irreversible/Irretrievable Commitments

The materials used for building the access roads and railroad spur as well as

maintenance of all affected roads would be irretrievably committed which is insignificant. The loss of life and property in transportation related accidents would be irretrievably committed.

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: 1

Resource Element	Committed Mitigation	Anticipated Impact: Baseline	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Transportation									
			Increase	in ADT	Hwy 40				
Coal		0	0	0	0	0	Good	Materials used in building access roads and rail spur as well as for maintenance of all roads would be irretrievably committed loss of life and property in transportation related accidents would be irretrievably committed.	Traffic would also increase dramatically on Moffat County Rd. 17 affecting area residence and wildlife through mine life.
Employee									
Segment A		0	100	150	150	0			
Segment B		0	50	50	50	0			
U.S. Hwy 40 Capacity		Increased	Volume	/Capacity	Ratio		"		Segment B service level would be lowered without the project. No signifient impact to either segment.
Segment A		0	.38	.48	.50	0			
Segment B		0	.83	.88	.97	0			
DRGW Railroad		None	None	Add 1 unit train per day	——→	None	"		New rail spur would add one new at grade crossing on U.S. Hwy 40 as well as increased noise and surface disturbance.

15. Noise

15.1 Affected Environment

The existing noise environment on tract is low level; approximately 25 to 35 dB, and consists of sounds from a natural, undeveloped environment as well as background noise associated with agriculture and periodic traffic on Moffat County Road 17. Existing noise levels along U.S. Highway 40 are estimated to be 66 L_{eq} (dB) at 100 feet for segment A and 68 L_{eq} (dB) at 100 feet for segment B (see Transportation). The DRGW railroad curentoy produces a noise level of about 85 L_{eq} (dBA) at 100' along the main line with 8 unit trains per day. A noise level of 50 dB is considered the threshold for uncomfortable noise for humans.

15.2 Environmental Consequences

The introduction of a new surface mine in the area would raise noise levels in and around the tract. Noise from a typical surface mine operation is estimated to be 78 dB at 500 feet from the source. Noise would be generated by mining activities such as coal trucks, heavy equipment, loadout facilities, trains, increased highway traffic and powerlines. Residences near the tract may experience an increase in noise which is assumed to be insignificant.

The increase in noise levels along U.S. Highway 40 are less than 1 dB which is insignificant. Traffic noise would also increase along County Road 17 affect residences and wildlife along this route.

Additional noise would be introduced by trains along the new railroad spur as well as the addition of one train per day over the main line. The noise level for a train along the new spur would be approximately 75 L_{eq} (dBA) at 100'. This is a large increase and could be significant if the new route is in close proximity of the developed residential area of Lay. This will be analyzed in the environmental assessment for the rail spur. Noise would increase 1 dBA along the mainline which is insignificant.

15.2.1 Unavoidable Adverse Impacts

Increases in noise levels as a result of a new mine would be unavoidable and adverse affecting residents and wildlife on or near the tract as well as along the railroad and highway corridors.

15.2.2 Short Term vs. Long Term

The noise impacts would last throughout the life of the mine, from construction through production.

THE SITE SPECIFIC ANALYSIS

Attachment 2A

Tract Name or Number: Lay Creek

State: Colorado

Leasing/Development Scenario: 1

Resource Element	Committed Mitigation	Anticipated Impact: Baseline	1992	1995	2000	EML	Data Reliability	Irreversible and Irretrievable Commitments	Comments (Context) (Proposed Mitigation)
Noise									
Sources		Natural and background from agriculture and traffic	Construction	Mine operation traffic railroad	———→	Natural and backgrond from traffic, agriculture and reclamation	Good		Significant increase on tract. Significance of increse depends on how residents perceive the increase.
		Increase	in Leq @	500'			Fair		1-2 dB increase in noise is insignificant. Significant increase in noise along new rail spur.
Levels on tract		0	43 dB	43 dB	43 dB	0			
Transportation levels			Leq	@ 100'			Fair		
Hwy 40 (A)		0	1	1	1	0			
Hwy 40 (B)		0	<1	<1	<1	0			
DRGW Railroad									
Main line		0	0	1 dBA	1 dBA				
New spur		0	30 dB	40 dBA	40 dBA				
Impacts to general population		None	Increased traffic noise on County Rd. 17 and trains would affect area residents and wildlife.			None	Fair		
Health and safety standards	MSHA regulations	None	Impacts to workers in high noise environment are mitigated.			None	Good		

16. Net Energy Analysis

Lay Creek Tract

Energy Inputs	Amount per Year (in BTUs)	Mine Life (30 Years)
1. Mining Operation	2.71×10^{11}	8.13×10^{12}
2. Product Transportation	11.94×10^{11}	3.58×10^{13}
3. Employee Transportation	1.62×10^{10}	4.86×10^{11}
4. Infrastructure Support	5.42×10^{8}	1.63×10^{10}
5. Total	1.48×10^{12}	4.44×10^{13}
Energy Outputs	3.46×10^{13}	10.38×10^{14}
Ratio (output:input)	23.38:1	23.38:1

Calculations

(1) Annual production x BTUs expended/ton
$1{,}678{,}133 \times 1.614 \times 10^{5} = 2.71 \times 10^{11}$

(2) Truck
Annual production x one-way haul loaded x BTUs expended
+ annual production x one-way haul unloaded

Train
+ Annual production x one-way haul loaded x BTUs expended
+ annual production x one-way haul unloaded x BTUs expended

$1{,}678{,}133 \times 5 \times 1900 = 1.59 \times 10^{10}$
$1{,}678{,}133 \times 5 = 8.39 \times 10^{6}$
$1{,}678{,}133 \times 1000 \times 392 = 6.57 \times 10^{11}$
$1{,}678{,}133 \times 1000 \times 311 = 5.21 \times 10^{11}$
Total 11.94×10^{11}

(3) # Total employees x # miles to work x 2 x 6250 BTUs x working days/year
$150 \times 20 \times 2 \times 6250 \times 350 = 1.31 \times 10^{10}$
$20 \times 35 \times 2 \times 6250 \times 350 = 3.06 \times 10^{9}$
1.62×10^{10}

(4) # people as result of project x 17,465 x 365
$85 \times 17{,}465 \times 365 = 5.42 \times 10^{8}$

Energy outputs = annual production x coal quality (BTUs/ton) (quality = 10,300 BTUs/lb)

$1{,}678{,}133 \times 20{,}600{,}000 = 3.46 \times 10^{13}$

Ratio = output divided by input = $(3.46 \times 10^{13}) \div (1.48 \times 10^{12})$